Charles University in Prague

Faculty of Social Sciences

Institute of Economic Studies

MASTER THESIS

2012 **Natalia Bejan**

Charles University in Prague

Faculty of Social Sciences

Institute of Economic Studies

MASTER THESIS

Evolution and Biases of Economic Forecasting

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Supervisor: **PhDr. Tomáš Sedláček**

Academic Year: **2011/2012**

Declaration of Authorship

The author hereby declares that she compiled this thesis independently, using only the listed resources and literature.

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Prague, May 15, 2012

Signature

Acknowledgements

I wish to express my gratitude to Mr. Tomáš Sedláček who has inspired me to create this work and contributed with useful insights, recommendations and corrections during the writing process.

I would also like to thank all of those who have made the IES experience special for me.

Bibliographic Record

Bejan, N. (May, 2012): "*Evolution and Biases of Economic Forecasting*." Master Thesis. Charles University in Prague, Faculty of Social Sciences, Institute of Economic Studies. Supervisor: PhDr. Tomáš Sedláček.

Abstract

In this work we offer an analysis of economic forecasting from two points of view: firstly, we analyze the historical interpretation of the time concept in ancient Egypt, Old Testament and ancient Greece; secondly, we assess the current state of economic forecasting accuracy, the empirical analysis being primarily based on the IMF data. We analyze the optimism bias presence in the IMF forecasts for the GDP growth rate and inflation rate, in a dataset of 30 selected countries, in the period between 2000 and 2010 years. We find the presence of optimism bias in both observed variables. Additionally, we evaluate the IMF forecasting performance of 15 developed versus 15 developing countries and find that on average the predictions for the developed countries are more accurate as compared to the developing countries.

Keywords economic forecasting, optimism bias, forecast evaluation, prophecies, forecasting history, forecasting accuracy, forecasting biases, forecasting evolution

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ACRONYMS

EPS	Earnings per Share
FE	Fixed Effects
IMF	International Monetary Fund
LAD	Largest Absolute Deviation
MAD	Mean Absolute Deviation
MAPE	Mean Absolute Percentage Error
MeAE	Median Absolute Error
MSE	Mean Squared Error
RE	Random Effects
RMSE	Root-Mean Standard Error
WEO	World Economic Outlook
OLS	Ordinary Least Squares Model
LSDV	Least Squares Dummy Variable Model

MASTER THESIS PROPOSAL

Author:	Bejan Natalia
Supervisor:	PhDr. Tomáš Sedláček
Topic:	Evolution and Biases of Economic Forecasting

Topic characteristics: My research will be focused on economic forecasting. Its state in the Ancient times (Ancient Egypt, Old Testament, Ancient Greece) in terms of indicators, methods and successfulness of the forecasting goals will be analyzed.

Further the biases which deteriorate the exactness of performed economic forecasting will be discussed, mainly assessing the different types of predictions (interpretational bias), as well as the human behavior bias from the point of view of the "this-time-is-different" syndrome, bounded rationality, affective forecasting, and animal spirit bias.

The empirical part of the thesis will be dedicated to assessing the relationship between forecasted and real data, by evaluating the optimism bias versus affecting forecasting. Moreover, a comparison between the forecasting accuracy will be done in order to assess the forecasting accuracy of the developed countries as compared to the developing ones.

Hypotheses: 1. The forecast of the positive-meaning economic variables is on average overestimated. 2. The forecast of the negative-meaning economic variables is on average underestimated. 3. Developed countries as compared to the developing ones are provided with a more accurate forecasting.

Methodology: A panel data for GDP growth rate and inflation rate will be used. Based on this data the comparison between forecasting performance of the developed and developing countries will be performed using the following methodologies: mean squared error, root mean squared error, mean absolute deviation. The optimism bias will be assessed based on the estimation of the forecasted data on the actual data, the model

being subject to both random and fixed effects analysis and comparison of the outputs. Consequently, the F-test will be used to assess the coefficients value.

Outline:

1. Introduction
2. Historical Overview of Economic Forecasting
3. Determinant Biases in Economic Forecasting:
4. Optimism Bias and Affective Forecasting
5. Forecasting Accuracy Evaluation
6. Conclusion

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I. INTRODUCTION

One of the main interests of economists is to forecast the future of systems behaviour. The birth of scientific macroeconomic forecasting, as Hawkins (2005) mentions, is a result of Keynesian revolution, when the number of quantitative-econometric models started to progressively increase. In this work, however, the analysis of economic forecasting will start with the very ancient roots and will discuss the time-concept interpretation as well as the influence of ancient methodologies of predictions on the current state of economic forecasting.

Such an approach to evaluate forecasting as a concept is, however, an unusual one given the wide variety of economic researches analyzing the empirical (numerical) aspect of predictions versus the poor exploration of the historical sides.

After pursuing an introduction to history, the biases influencing the current economic forecasting accuracy will be analyzed. We primarily consider the human behaviour biases which, due to their recognized influence on the economic development in the last period, developed into a separate science: behavioral economics.

The human behaviour influence on the predictions performance is channeled not only via erroneous interpretation of the forecasts (e.g. through *hindsight bias*), misuse of information (e.g. *identity concept*), but also via upwards or downwards deviations at the level of forecasts themselves which can be caused by the optimism bias. The former one is evaluated in this work.

Although the optimism bias has been already analyzed in different researches, most of them focus on either large datasets but older time-periods (e.g. Timmerman (2006) analyzed the data for 178 countries in the 1990-2003 period; Tagaci & Kucur (2006) – 109 countries with the data for 1994-2003 years; etc.), or more recent periods, but small datasets (e.g. Julio and Esperança (2012) – dataset for 1994-2010, in G7 countries). The value-added brought by our analysis is the combination of a relatively larger number of countries (30 countries) with the most recent available data (2000-2010).

From the other side, we analyze not only the human behaviour, but also the "forecasting errors behaviour". Usually the forecasting errors are interpreted as a methodological tool to compare several forecasting methods (models). However, there have been identified no attempts for comparing the forecasting performance of certain groups of countries. Respectively, we evaluate and compare the economic forecasting accuracy of a group of developed and one of developing countries.

The respective idea is transformed into the hypothesis that, given a more volatile economic growth in developing countries and their specialization in fewer economic sectors (non-diversification), we consider the economic forecasts for developed countries being more accurate as opposed to least developed countries where higher errors are expected.

Respectively, the objective of this thesis is to analyze the accuracy and biases of economic forecasting (primarily based on the IMF data) by first introducing the concept of forecasting from historical perspective. The reasoning behind the importance of this subject lies in the impact of economic predictions on the economies development.

This impact is channeled via policy-makers who base their decisions on the information about the potential state of the economy provided by forecasts, as it is claimed by Elliott & Timmermann (2008), the value of the forecasts can be assessed only via examining the outputs of policies and decisions which were taken relying on forecasted data.

The thesis is structured as follows: Chapter 2 is a backward induction analysis of ancient forecasting regarded from three perspectives: ancient Egypt, Old Testament and ancient Greece. We introduce the ancient interpretation of the time concept, as well as the methodological differences between current forecasting tools and ancient ones.

Chapter 3 covers the main biases related to human behavior including: this-time-is-different-syndrome, bounded rationality, animal spirit bias, unbounded emotionality. The chapter also discusses the importance of distinguishing between unconditional and conditional forecasting as suggested by Popper (1959).

Chapter 4 addresses the question on economic forecasting performance, comparing the accuracy of IMF forecasts in 15 developed and 15 developing countries. Using several technical measures, involving the forecast error as the main indicator, the respective

comparative analysis attempts to show the existence of a negative correlation between the level of countries' development and the forecasting inaccuracy.

Chapter 5 introduces the optimism bias and tests its presence in the IMF forecasts for the GDP growth rate and inflation rate. The analysis is based on two sets of tests: the test for efficiency of projections and the test for unbiasedness of projections, according to the methodology of Barrionuevo (1993).

The final remarks and conclusions are pointed in Chapter 6.

II. HISTORICAL INTERPRETATION OF THE TIME CONCEPT

The reason for learning about the economic forecasting starting with its roots is wonderfully explained by Aristotle, who said:

> "If you would understand anything, observe its beginning and its development."

Following this logic, as long as economists did not perform excellently in making fully accurate predictions, it is worth going deeper into the past and analyzing the birth and development of the *science* of forecasting.

It is generally accepted that macroeconomic forecasts, as we interpret them today, are a product of the Keynesian revolution, given that official forecasts started to be regularly produced after the World War II, as Hawkins (2005) mentions. But prediction of the future was a concern for the humanity long before Keynes birth. And the way today people interpret the future is certainly an output of the way the future was interpreted thousands of years ago. Respectively, the three historical perspectives on forecasting and on the time-concept that are analyzed in this work refer to ancient Egypt, Old Testament and ancient Greece.

The reason for selecting these three pages from the human history lies behind two arguments. Firstly, each of them had and has a strong influence on the humanity: ancient Egypt – as one the very first civilizations, Old Testament – as one of the most powerful religion platforms, and ancient Greece – as a mathematics and philosophy building block. Secondly, all three of them are interconnected: ancient Egypt is frequently quoted in the Old Testament, while ancient Greece has its roots in the ancient Egyptian rationale, given that several well-known Greek thinkers got their education in Egypt, being accused of, consequently, stealing Egyptian philosophy, as it is claimed in James (2010).

In this frame, the reason of this chapter is not to solve the problems that economic forecasting encounters, but to identify and asses how it all started, what was the ancients interpretation of the time concept, what was the methodology to predict the future, what

difference exists between the ancient methods to foresee the future and the current ones, and whether there is anything we succeeded to improve comparing to them, so far.

2.1. Ancient Egypt

> *"Sometimes, however, in its affection for forecasting, economics exhibits a nostalgia for magic." (McCloskey 1992)*

Egypt is one of the very first civilizations in the world. Fully understanding the spirit and evolution of Egypt can hardly be done even by the Egyptians themselves whose identity and history are simply an undiscovered mystery. Ancient Egypt faced challenges unknown to any other nation or country in the world: longest reign in the world history[1], shortest reigns[2], an impressive relationship between people and a river[3], as well as their impressive *ability* to forget how to read their own language[4].

Egyptians believed in a predetermined future and that their fate was sealed to them by the gods at birth. All life circumstances were known by the gods, as Toledano (2004), writes, even the date and time of their death. They also believed that there are days in the calendar which will bring sadness, and days which will be full of joy. But even if their beliefs were limited by these frames, Egyptians and the Near East in general are considered to be the first who developed the basics of philosophy.

Unlike Greeks, who were the first to develop a system of intellectual principles and fixed rules to define philosophy, the Egyptians delivered it as a system of human thoughts. As Allen (1988) writes, for the ancient Egyptians the philosophy and religion were identical, and, furthermore, Brier (1981) finds that neither magic was distinguishable from religion.

According to Toledano (2004), even with the belief in a predetermined future, Egyptians still considered that they can convince their gods to modify their initial plans on people's

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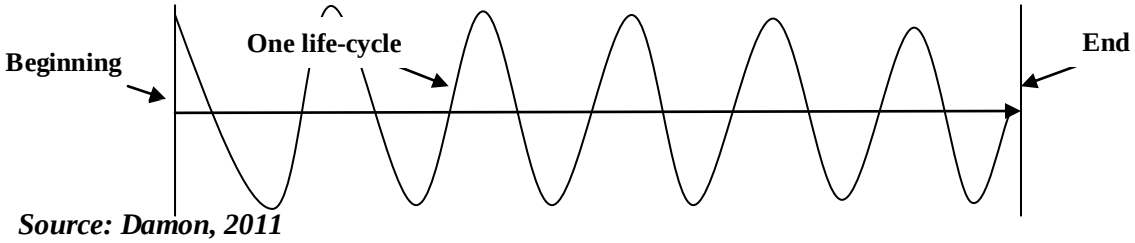
[1] "[…] pharaon Pepi II – whose ninety-four-year reign is the longest in the history of the world." Brier: *Ancient Egyptian Magic*, 17.
[2] "First Intermediate Period – […] There was such turmoil that the priest-historian Manetho says that, at one point, there were seventy kings in seventy days." Ibid., 18.
[3] "[…] the history of Egypt became so closely associated with the Nile that to understand the civilization one must understand the river." Ibid., 14.
[4] "The old man told to Germanicus that he was the only man alive who could read the writings of the Egyptians […]. In the early first century A.D., when Germanicus visited Egypt, few could read hieroglyphs, and soon any knowledge of the sacred script was to die." Ibid., 22.

fortune. Respectively, the matter of forecasting the future was not only a question related to faith and religion, but also to occultism and magic.

2.1.1. Cyclicality in a Materialized World

Although the ancient Egyptians interpreted time as having a beginning and an end, the period between these two points was not seen as linear, but represented by renewable cycles, as Damon (2011) specifies. Cyclicality is defined by Mircea Eliade (1956) as non-uniqueness of all: "*nothing being lost and nothing created*", all "*have already been produced in previous cycles and will be reproduced in subsequent cycles*". Similarly for Egyptians, time was considered an internal, intellectual structure and relationship between events, while the neat division of past, present and future did not apply as mythical time, according to Damon (2011), could repeat itself, be reversed, and renewed.

Figure 2.1: Ancient Egyptian Interpretation of Time



Source: Damon, 2011

The daily sunrise and sunset (in cycles) were seen by ancient Egyptians as solar immortality and represented an example that everyone wished to follow:

> [*Sunset represents*] a cyclical course of life, return to the origin, overcoming death, consummation as conception, and restoration through (re)birth. Here, longing for immortality is fulfilled in the cyclical time of endless renewal, as an imitation solis. (Assmann 2005, p. 174)

Egyptians delivered the very first historically registered business cycles, which is mentioned in the Old Testament and involves Pharaoh's dream interpretation by Joseph. The dream is explained as a 7-year economic cycle, while the solution is known today as fiscal intervention:

> The seven good cows are seven years, and the seven good heads of grain are seven years; it is one and the same dream. The seven lean, ugly cows that came up afterward are seven years, and so are the seven worthless heads of grain scorched by the east wind: They are seven years of famine." (Bible, Genesis 41:26-27)

But cyclicality was not attributed only to material world, but also to supreme entities: *self-developing gods*, who would cyclically renew their power (Allen 1988) and who would have the supremacy not only on all grounded things but on the numbers also:

> I am the one who stills the sky […]
> I am the one who silences the earth […].
> I found myself as a man of infinite number:
> I am the begetter of repeated millions
> Out of the Flood, Out of the Waters,
> Out of the Darkness, out of the Chaos.
> It is I who am Shu, begetter of the gods.
>
> (Allen 1988, translation of *The Cenoptach of Seti*, p. 15-19)

Egyptians, as one of the oldest civilizations on earth, were the source of inspiration even for the Greeks who later on advanced in the knowledge of mathematics and geometry (Sedlacek 2011). For Egyptians mathematics was inseparable from philosophy and mysticism since all numbers and dimensions had their specific interpretation, as it is for example the spatial dimension and specific location of the Egyptian pyramids (specific blocks dimension, specific pyramid slope angle, specific ramps structure, etc.).

The supreme authorities in Egypt were always associated with materialized objects, being it water or sun; furthermore, some of the gods were named after particular parts of the Nile Valley (Rice 1999). Generally, Nile River played a special role in Egyptians' history. The river is mentioned in the very first documented economic forecast related to harvest prediction:

> If it was a good year and the river was high, crops were abundant. If it was a bad year and the river was low, it would not cover as much of the land, and crops would be reduced. In times of extremely low river, famine was a reality. (Brier 1981, p.15)

Thus, the level of the river was a good predictor of harvest expectation. In nowadays economic terms, the harvest can be interpreted as a proxy of GDP, taking into account that the economy of Egypt in ancient times was mostly agricultural (Toledano 2004). Thus, an economic crisis for the ancient Egypt could be associated with drying Nile.

According to Brier (1981), unlike Jews, who had a very good delimitation between magic and religion, the Egyptians practically mixed the two. However, even the meaning of religion for the ancient Egyptians was different from the way we understand it currently. First to mention, Egypt was a theocracy – its political ruler was the God for the country. And because he could not be present at all the ceremonies that were happening in the country in all the temples, there were certain people delegated that were attending those

ceremonies, representing the ruler – the God. And because these ceremonies took place few times a day, every day a week, those people got linked to certain places and their position transformed into what we call today *priesthood* (Brier 1981).

Cyclicality was present even at the level of those representative priests who were working in a system of rotation, the vast majority of the Egyptians having the duty to *represent the God* for a certain number of days per year. And even at that level, the physical appearance was the most important element, the representatives having to shave their body, bath four times a day, while no moral standards were required or imposed, which explained all the stories in which Egyptian priests behaved scandalously (Brier 1981).

2.1.2. Ancient Egypt Methods to Forecast the Future

The ones who actually had the power of predicting events, interpreting dreams, make someone fall in love, cure an illness were ancient Egyptian magicians – a special rank of priests who lived in *The House of Life*[5] and could maintain their power only as long as they kept away their books from all who could read them (Brier 1981), taking into account that there were very few people in the entire Egypt who could read.

> According to Herodotus, the Egyptian Priests possessed super-natural powers, for they had been trained in the esoteric philosophy of the Greater Mysteries, and were experts in Magic. They had the power of controlling the minds of men (hypnosis), the power of predicting the future (prophecy) and the power over nature. (James 2010, p. 22)

Secrecy was an important tool to inspire power and grandiosity and without having something hidden nobody would be considered to be a predictor (Emerson 2006). The period of ancient Egypt is classically defining the birth of *gnosis* which is, however, technically associated with Greek history. However, certainly the mystery in religion, the dualism between good and evil were defining treats of the ancient Egypt too, as McBride writes in his book, *The Egyptians Foundations of Gnostic Thoughts*,

> […] Egyptian theology differentiated between "the man of knowledge" (*rhw*) and the ignorant (*ihmw*). (McBride 1994, p. 57)

Many Egyptian magical books had the world "*secret*" in the name: *The Book of Knowledge of the Secrets of the Laboratory* or *The Book of Knowing the Secret Forms of the God*. These magical books were not just restricted to public, but were also hardly

[5] "House of Life is well known as a place connected with the activities of the most learned scribes of Egypt." Gardiner, *The Mansion of Life and The Master of the King's Largess*, 83

readable being extremely sophisticated, such that even nowadays some of them can't be translated (Brier 1981).

Similarly to current economic modeling, the ancient magician-priests discussed on a regular basis their secrets and ways to influence the future. They determined specific words and incantations each of them having a very specific role:

> The primary job of the more learned scribes was to clarify religious and magical texts, to supply missing gaps in papyri, and to develop new texts and spells when events called for them. They were also responsible for determining the texts to be carved on the walls of newly erected temples. One can imagine these priests arguing for hours over some theological point or over the wording of an incantation. (Brier 1981, p. 44)

But even with a full house of magicians and priests, there was a significant delay when it comes to execution and actual forecast of the future. This gap damaged magicians' reputation, but there was only one person who could never be accused of trickery – the pharaoh.

By virtue of his position the pharaoh was considered more powerful than any other magician. The Egyptians believed that when pharaoh is sick – the whole country is underperforming; when the pharaoh is getting old – the country is weaker in battles. And when a pharaoh dies, the country is in a mourning period (Gadalla 2008). The Egypt's life was considered to be a reflection of pharaoh's life.

Another ancient Egyptian mystery is linked to **Oracles**. These were stone statues used to forecast the future and to obtain divine guidance, being not even one discovered nowadays. According to Brier (1981), Oracles were kept in the very last room in the country temples. They could also act as judges in courts of law, even though they could not talk – these were just stone statues, people pretended to understand their answers.

For the Egyptians themselves, the most relevant predictors were believed to be the properly interpreted **dreams**. The dreams of materialized objects were considered the most powerful ones (Bar 2001). The oldest book for dreams interpretation, about 4000 years old, has also Egyptian origins: *Egyptian Dream Book*. Not only because of its age, but also because of the mysterious character of the Egyptians, many of the interpretations are contradictory. For example, if a man sees himself dead, it is good, predicting a long life (Bar 2001); the explanation mechanism remains unknown.

Finally, ancient Egypt remains as a remark of magic, secrets, dreams and early cycles in the human history. Even though for the Egyptians the representation of the world and of the future was symbolist, mysterious and much more superficial than we interpret it today, Egypt gave birth to basic thinking about the future which is supported by both: very first documented economic cycle and the very first documented economic forecast.

Additionally, it established an organizational, structured frame for this thinking: division of responsibilities, birth of priesthood, social hierarchy. Not least to mention, ancient Egypt represented a building block and source of inspiration for the forthcoming societies (e.g. ancient Greece) to continue exploring philosophical truths about the time.

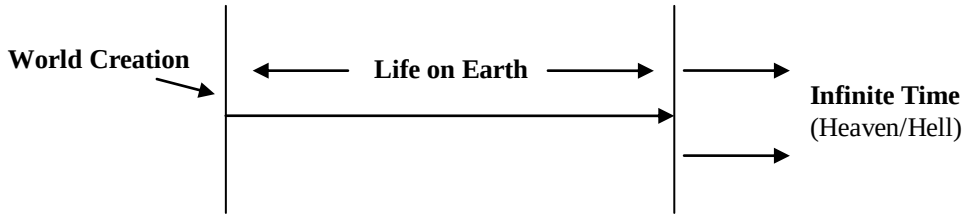
2.2. Old Testament

According to the Old Testament, the world was created using careful knowledge and wisdom, out of a very well-organized set of *actions* and *activities* performed by a unique God during six days[6]. At the very bottom of world creation there was no chaos but a determined history to go though:

> The Jewish understanding of time is linear – it has a beginning and an end. The Jews believe in historical progress, and that progress is in this world. (Sedlacek 2011, p.47)

The linear time interpretation (Figure 2.2) implies the uniqueness of everything happening on the earth, the *irreversible* and *irrevocable process* (Cullhed 2001), as well as the permanent move toward a goal that lies outside history. This can be regarded not exclusively and mandatory linear but also as a single circle (Jackelen 2005).

Figure 2.2: Old Testament Interpretation of Time



Source: Author's representation

[6] "In the beginning God created the heaven and the earth. And the earth was without form, and void; and darkness was upon the face of the deep. And the Spirit of God moved upon the face of the waters. And God said, Let there be light: and there was light. And God saw the light, that it was good: and God divided the light from the darkness. And God called the light Day, and the darkness he called Night. And the evening and the morning were the first day." Genesis 1:1-31, Old Testament.

Surely there is a future[7] and there can be only two options for the state of *this* future: a *free-will*[8] or a *predetermined story*[9]. The contradiction between the two reveals that if one holds, the other should be excluded. The same rationale applied Karl Popper (1959) explaining the difference between a conditional and a non-conditional forecasting (Chapter III, 3.3.).

In the Old Testament, however, the hierarchy between people and God is clearly visible and, thus, the future is interpreted as an indefinable model and only prophecies have access to it. Still, even with no access to the future the Jewish people were those hoping for something more for that future, this is why Jews are considered to give birth to capitalism.

> […] *M*odern capitalism owes its being to money-lending. This was the case wherever it was necessary to lay out money for initial expenses, or where a business was started […]. The money-lending activities for the Jews were thus an objective factor in enabling the Jews to create, to expand and to assist the capitalistic spirit. (Sombart 1911 [2001], p. 133)

Moreover, quantification and numerology was an important detail to which in the Old Testament is attributed an essential place. Even back then, number mysticism (which centuries later developed into Kabala school of thought) was a science of knowing the past, present and future. It was believed that the Old Testament itself was written in a secret code which could be deciphered only with numbers (O'Brien 2007).

It was not only the mysticism behind the *sacred numbers*, such as *1* (singular form of God), *7* (creational days), *10* (Ten Commandments, known as Decalogue) or *666* (the number of the beast). The importance of numbers and their interpretability lies even behind the structure of the Old Testament itself. Nowadays it is composed out of 37 books which according to the ancient rearrangements and grouping (done before Old Testament appeared as a compilation of books we know today) are in fact 22 books each of them representing one letter from the old Hebrew alphabet:

> Observe further that there are two and twenty books of the Old Testament, one for each letter of the Hebrew alphabet. (John of Damascus 7th century [2012], p. 89)

---

[7] "Surely there is a future, and your hope will not be cut off." Bible, Proverbs 23:18.
[8] "There is hope for your future." Bible, Jeremiah 31:17.
[9] "For I know the plans I have for you, declares the LORD, plans for welfare and not for evil, to give you a future and a hope" Bible, Jeremiah 29:11 which contradicts with Exodus 32:14: "So the LORD changed His mind about the harm which He said He would do to His people."

Moreover, if looking at the whole Bible, the number of total books in New and Old Testament account for 49 which is demystified by numerologists as 7×7. According to Ernest L. Martin (2004) this combination represents *completion* and *finality*.

Number 7 is also present in the very first business cycle which was introduced in the ancient Egypt section (Chapter II, 2.1). Joseph deciphered Pharaoh's dream as a 7-year economic cycle, while the following *fiscal intervention* saved Egypt from starvation.

Dreams are one of the most frequent methods of prophesying in the Old Testament. Generally, there are two types of dreams: **prophetic** and **symbolic** (Bar 2001). In a *symbolic* dream the visual is crucial – Pharaoh's dream interpreted by Joseph is an example. The visualization of the cows and deciphering the message is the main goal of the interpreter. However, the *prophetic* dreams are more straight-forward: a clear, unambiguous verbal message is transmitted, as in the Solomon King dream,

> At Gibeon the Lord appeared to Solomon during the night in a dream […] "I will do what you have asked. I will give you a wise and discerning heart, so that there will never have been anyone like you, nor will there ever be." (1 Kings 3:5-12)

Moreover, the importance of the dreams is revealed by the incapacity of distinguishing between it and reality in several stories in the Old Testament. As an example can serve the wrestle of Jacob with the angels that came to him in the night:

> And Jacob was left alone; and there wrestled a man with him until the breaking of the day. And when he saw that he prevailed not against him, he touched the hollow of his thigh; and the hollow of Jacob's thigh was out of joint, as he wrestled with him. And he said, Let me go, for the day breaketh. And he said, I will not let thee go, except thou bless me. (Genesis 32:24-26)

The Old Testament made a clear differentiation concerning ownership and the right to access the information regarding the future. In the current state of economics we cannot affirm that there is an owner per se of GDP (harvest), inflation (money), consumption (food) etc. Only for conventionality we can think about the state, population or central monetary institutions, Central Banks. However, in the Old Testament the ownership is clearly determined: God is presented as the ultimate owner of all created things. This idea is essential in the Bible and is the basic idea to human stewardship (Graafland 2001). And it is not just the ownership alone, but also the right to explore.

The prophecy concerning the destruction of Babylon[10] is a relevant example of the God's ownership (Graafland 2001). It implied that Babylon is meant to be destroyed because of its desire to get more than what it was given by default. Besides, the way the prophecy is done reveals that Babylon was not just a city of the past, but represents a generalization of all ever-existing sinful cities which are predicted a sorrowful ending.

2.2.1. Prophecies and Forecasting – What Makes the Difference?

There are several arguments to explain the existing difference between the prophecies from the Old Testament and the concept of forecasting known by us today.

The Message Generator and Intermediaries

Unlike the economic forecasting performed by trained people - economists, the prophecies made in the Old Testament come directly from the God. In all cases, predictions (named *prophesies* in the Bible) are made with God' interference suggesting that there is no way in which a simple human being can know how the future is going to be like (again reverting to the idea of God's ownership and his absolute power).

However, in the Old Testament the place of economists is represented by intermediaries – prophets who had the role of deciphering and/or transmitting the message from the supreme power to ordinary people:

> I will raise up for them a prophet like you from among their brothers; I will put my words in his mouth, and he will tell them everything I command him. (Deuteronomy 18:18)

Accordingly, the difference between prophecy and forecast is the presence of God in the first and his absence in the latter, given the existence of intermediaries in both cases. Robert Nelson is the one who developed the idea of economics and science as such being a new tool invented by the people to replace God (or gods) with a platonic imitation which would be as powerful as the God itself is. We have replaced the God with economics and the prophets with economists.

[10] The full Babylon prophecy: Revelation 18:1-24, Old Testament. The destruction prophecy: "Then a strong angel took up a stone like a great millstone and threw it into the sea, saying, "So will Babylon, the great city, be thrown down with violence, and will not be found any longer." Revelation 18:21, Old Testament.

> [The] basic role of economists is to serve as the priesthood of a modern secular religion of economic progress that serves many of the same functions in contemporary society as earlier Christian and other religions did in their time. (Nelson 1991, p. XV)

Moreover, economists not only replaced God, but remodeled the interpretation of the heaven as the ultimate goal by transforming it into a "*heaven on earth, yet another economic road to salvation, yet another modern economic theology*" (Nelson 1991). But this replacement still keeps the forecasts distant in accuracy from prophecies.

The Goodness of Fit: the difference between Truth and Probability

The prophecies in the Old Testament have no scientific explanation and usually not even a non-scientific one; they are just to be believed. And unlike economic forecasting where economists are making a tentative to predict the future, the prophecies represent an absolute fact excluding the doubts in its realization:

> Prophecy – a statement about what is going to happen in the future. (Oxford WordPower Dictionary 1988)

> […] Prophecy, or the belief in any of the truths taught in Scripture. (Maimonides 1904, p. 263)

> […] the prophet is unconditionally superior […] He can know directly, without "premises and conclusions," what all other men can only know indirectly. (Strauss 1995, p. 85)

Economists, instead, are considering *probabilities* and *possibilities*. Additionally, when preparing a forecast, economists are mandatory relying on the lived experiences, while prophecies do not rely on any facts. These arguments highlight that the general difference between forecast versus prophesy is the reliability on some scientific versus non-scientific arguments.

What from the Old Testament lesson can be concluded is that the future can be exactly known only if there is supreme power interference. The rationalization of the source or methodology of knowing the future is not explainable using scientific words, while the non-scientific interpretation is ignorable nowadays. The forecasting methods that are currently being used by the economist differ significantly from the Old Testament ones in terms of goodness of fit, credibility, intermediaries and source (generator). Dream – as a forecasting tool, remains in the Old Testament as powerful and as reliable as it was for ancient Egyptians. The difference consists only in the persistently universal power of a unique God in all forecasting methods in the Old Testament.

2.3. Ancient Greece

If for ancient Egyptians the time-interpretation was cyclical, while according to the Old Testament it was linear, than for the ancient Greece the universe and the time was a product of chaos which has irredeemably fallen out of the cyclical time in nature (Assmann 2005).

> Chaos implied that having an accurate model of a system wasn't enough to predict its future evolution. […] In a non-linear system, the strategy of breaking the whole down into its components would no longer apply because, like a haiku poem, the whole would be more than the sum of the parts. (Orrell 2007, p. 102)

The role of its greatest minds: Thales (7th Century B.C.), Pythagoras (6th Century B.C.), Socrates, Xenophon, Plato (5th Century B.C.), Aristotle (4th century B.C.) – was to find a reasoning behind the world's chaos and to explain it.

It is widely recognized that ancient Greece put the most important building blocks to the modern mathematics as well as philosophy, such that the best summarized description for the ancient Greek brilliant minds would be: "*developers of mathematical-philosophical truths*" (Sedlacek 2011).

However, before the development of philosophy and mathematics in the ancient Greece, the prediction of the future was done by one of the most well-known forecasters in the world history. The Oracle of Delphi – which according to the legend was a cursed worship site for the Apollo god (Orrell 2007) – attracted the people from all over the world. Cassandra and Pythia were two oracles, foretelling instruments that verbalized the predictions to the people.

Although the Oracle of Delphi had an impressive reputation, the accuracy of predictions and their interpretability was less remarkable given also that the rituals were extremely costly. The oracles never gave a yes-or-no answer and finally it lost its reputation and authority due to discrimination issues and unclear answers.

2.3.1. Rejecting Traditional Thinking – Birth of Philosophy

Even though for many ancient Greek intellectuals (Plato, Pythagoras, Thales) Egypt was the primary source of education and inspiration (James 2010), Greece alone had a much more profound footprint to leave on all the forthcoming generations.

The Oracle of Delphi was replaced by the Greek philosophers who problematized the issues of identity and self-awareness (Sorabji 2006). While the Oracle of Delphi encouraged people to come and seek for an answer from the supreme powers, the Greek thinkers encouraged to look for the answers inside ourselves.

Greeks were the first who dared to reject traditional doctrines of supernatural forces or superstitions and started to examine the world in its whole complexity:

> The Greek intellectuals adopted a totally new attitude toward nature. This attitude was rational, critical, and secular. Mythology was discarded as was the belief that the gods manipulate man and the physical world according to their whims. […] In short, nature is rationally designed and that design […] can be apprehended by man's mind." (Kline 1982, p. 10)

But the influence of the Greek thinkers on the forthcoming societies did not consist only in rejection of the traditional thinking but also in delivering a new set of standard and beliefs to guide. As Bertrand Russell writes in *Mysticism and Logic*, the change through which Greek thinkers went through can be named as a philosophical illumination period.

> The first and most direct outcome of the moment of illumination is belief in the possibility of a way of knowledge which may be called revelation or insight or intuition, as contrasted with sense, reason, and analysis, which are regarded as blind guides leading to the morass of illusion. Closely connected with this belief is the conception of a Reality behind the world of appearance and utterly different from it. (Russell 1918, p. 10)

Losing faith and connection to supreme powers was additionally influenced by the wide multitude of gods that the ancient Greece encountered, as well as the indifference between worshiping one of them or another. And unlike the Old Testament case where only one God was recognized, the Greeks had to deal with many of them:

> Christianity adds that God is love and a Father who cares for every one of his children. […] The issue between monotheism and polytheism, so vital to the Jew, seemed to the Greek a matter of small importance. Even Plato, in a context where the very nature deity is in question, will speak of "God" or of "the gods" indifferently. (Cornford 1923, p. 10)

The transition from a traditional religious society to an *inside-oriented* one was not an easy process. As it is mentioned in one of Plato's dialogues, Socrates testified that he was condemned to death because of insulting the sanctity of religion.

> He says that I am a maker of gods; and so he is prosecuting me, he says, for inventing new gods and for not believing in the old ones. (Plato 399BC [1963], p. 8)

Philosophers originated their justification in the need of finding their own truth and their own explanation to the questions they were concerned about. One of those questions was the power of the people over time. As it was already mentioned, the interpretation of the

time in the ancient Greece was associated to chaos, however, the time flow was believed of having a non-chaotic character.

Pythagoras thought that time moves in circles (Orrell 2007); however, the circles are never repeating themselves, but having a *built-in* component error so that it always deviates from expectation and thus we interpret it as a chaos. Hesiod, an ancient Greek historian, determined that the time can be divided into five segments, "*beginning with the golden age in a remote past, where human beings lived in peace with each other and in harmony with nature, down to the miserable contemporary age of iron, characterized by dispute and warfare*" (Cullhed 2001). Heraclitus, Greek thinker known for his insistence to believe that nothing repeats itself, believed, as Bertrand Russell notes (1918), in universal flux: "*time builds and destroys all things.*"

On the other side, Plato considered that there is nothing random and everything can be known in advance if we would learn to understand the chaos (Orrell 2007), since time follows a logical path.

> According to Plato, the tracks of truth […] of this world lie somewhere deep within us, where they are written even before we are born. If we were to search for them, it would suffice to turn to our own interiors. Searching for truth in outside world is misleading and distracting, because it leads us to a path of following and examining shadows. (Sedlacek 2011, p. 105-106)

The main achievement of Greek philosophers was inspiring human brains to ask, think and look for answers. But the method of actually thinking and formulating the questions and answers was also a new one. Ancient Greeks injected into the all forthcoming generations the addiction to numbers.

2.3.2. Mathematics and Quantification: Pythagorean Language

"All is number."

(The Pythagorean School dictum)

The Pythagorean School brought an enormous contribution to nowadays sciences given that most of them are based on mathematics.

Pythagoras himself was said to be born as a prediction of the Oracles (Orrell 2007). He believed that numbers represent not only quantity, but also quality by which he developed the *numerical mysticism* (Sedlacek 2011). According to Pythagoras, the highest form of prediction was divination through numbers: he didn't just predict the future using

numerical tools; "*he also helped define it*" (Orrell 2007). The definition of mathematics was ingeniously done through creating a new language which was the mathematics itself. This language helped to copy the reality and transpose it into quantifiable expressions or, as Wittgenstein formulates it,

> […] *G*enerality which we need in mathematics is not the accidental one. The propositions of logic are tautologies. The propositions of logic therefore say nothing. (They are the analytical propositions.) (Wittgenstein 1922, p. 76-77)

> 'Mathematical certainty' is not a philosophical concept. […] *C*ertainty is […] language-game. (Wittgenstein 1958, p. 224)

The mathematics that Pythagoras developed was interpreted as a separate language which was both universal and mandatory provable. Thus, the need to attest a statement and the universal applicability of the numbers and quantification became a defining threat of the math-language.

(i) **The need of proof.** Pythagoras himself brought to mathematics more than the Pythagorean Theorem. He is considered to be the first important explorer of mathematical figures, mathematical principles and the idea of proof.

> […] all proof and all persuasion is part of science. (Fairbanks 1898, p. 145)

Pythagoras considered that proof is an inseparable tool of showing the truthfulness, while he himself did not consider appropriate to give explanations to his own calculations. Some of his theorems were taken as a rule by his students and none had enough courage to ask for a proof unless it was just shown (Orrell 2007).

(ii) **The quantification of everything.** For Pythagoras all things were measurable and all could be represented by a geometrical figure, thus numbers and mathematics became an universal tool to understand the world:

> Pythagoras said that time is the sphere of what surrounds the world. […] The universe is made from five solid figures, which are called also mathematical; of these he says that earth has arisen from the cube, fire from the pyramid, air from the octahedron, and water from the icosahedron, and the sphere of the all from the dodecahedron. […] The sun is spherical." (Fairbanks 1898, p. 146-147)

Moreover, each of these figures had an argumentative support behind such that, for example, the association of the air with an octahedron could be extended to the following:

> Air is composed of forty-eight triangles, surrounded by eight equilaterals. And it is compared to the octahedron, which is surrounded by eight equilateral triangles, each of which is separated into six right-angled triangles so as to become forty-eight in all. (Fairbanks 1898, p. 155)

Even though the inspiration of Greek thinkers is proved to have been inspired from Egyptians, the Greeks did an impressive step forward and provided the forthcoming generations with a strong building block for the development of the mathematical-philosophical truths. But the greatest success that Greeks achieved was the encouragement of thinking, expression and proving. They were the first to require justifications and logical support, and denied traditional superficial attitude. Starting with ancient Greece and till nowadays people are in search of their testable truths.

2.4. Concluding: What is Old and What is New?

There are thousands of years that trace a line between now and the ancient societies discussed previously. The evolution of the civilizations does not mandatory imply that the development progresses in all directions. Some methods of forecasting the future progressed; others got forgotten or disregarded.

The current ignorance of non-scientific methods of foreseeing the future explains why the range of methodological tools used for forecasting in ancient times was much wider than the focus on the empirical judgment alone on which we fully rely nowadays.

Some of those forgotten methods are: dreams, magic, religion, belief. Dreams were one of the most important and credible forecasting methods for ancient Egyptians and for Jews. Magic was a field opened only to authoritative people in Egypt, while religion and belief were the drivers in the Old Testament. Ancient Greece had a more transitory place between ancient societies and modern world. And as it will be further discussed, many current forecasting methodologies were born and developed by Greek thinkers.

The forecasting can be generally divided into two approaches: the **qualitative** and the **quantitative** ones. While the current qualitative methods refer to informed opinion, judgment, market research and historical life-cycle, the quantitative methods refer to prediction of the quantifiable variables based on some past available data.

The field in which we advanced today compared to the ancient civilizations is sophisticated **quantitative methods**. The addiction for numbers that Greeks gave birth to is the main driver of the current forecasting field, the vast majority of economic

forecasting methodologies relying on numerical methods while none of them advancing to persistently give an accurate prediction.

Bryan and Molloy (2007) found that there is very little evidence that any forecaster from 1983 till 2007 consistently predicted better than the median forecast and, further, forecasters who gave better than-average predictions in one year are unable to sustain their performance — at least no more than random chance would suggest. Veress (2012) also investigated the quality of forecasts. The analysis compared the performance of different groups including governmental employees, academicians and bankers. According to the results, none of these three groups is able to achieve a better performance than the naïve forecasters.

Right after quantification has to be mentioned the nowadays requirement for **proofs**. For ancient Egyptian, for the Greek Oracle of Delphi, as well as for the Jews, the proofs of a forecast were never required. The credibility was absolute, as well as the power of the forecasters over the normal people (being it God for Jews, oracles for Greeks or Pharaoh and priests for Egyptians). As Karl Popper mentioned referring to the developing scientific theory:

> Now I hold that scientific theories are never fully justifiable or verifiable, but that they are nevertheless testable. I shall therefore say that the objectivity of scientific statements lies in the fact that they can be inter-subjectively tested. (Popper 1959, p. 22)

The requirement for testing the theories has its roots in ancient Greece who developed through the Pythagorean School the idea that believable theories are those theories that have been proved.

Another new tool used by economists to predict the future is **conventionalism** (Chapter III, 3.4.) and the full reliability of our complex world on some simplified, minimalistic assumptions such as ceteris paribus[11], or simplifications that rule out the structural changes: constant, time-invariant data generation processes, stationarity, model uniqueness (Clements and Hendry 2008). While nowadays economics is ruling out certain details considered irrelevant, the ancient forecasts were actually based on scientifically ignorable facts.

[11] "Questions concerning ceteris paribus clauses are closely related to questions concerning simplifications and idealizations, since one way to simplify is to suppose that the various disturbing causes or interferences are inactive and to explore the consequences of some small number of causal factors." Hausman, *Philosophy and Economics*, 87.

The **cyclicality** is another feature that has its roots in ancient times which has grown today into a separate branch of economics named business cycle theory. Referring to cyclicality in 1930s John Kenneth Galbraith writes in *The Affluent Society*,

> At the beginning of the decade, it was almost uniformly assumed that cycle fluctuations […] are inevitable. […] By the end of the decade, under the combined influence of Keynes and the sanguine and experimental mood generated by New Deal, there was a widespread belief that depressions could be at least partially prevented. The notion that they must be allowed to run their course was virtually extinct. (Galbraith 1960, p. 88)

The very first documented business cycle, discussed already, introduced the 7-year fiscal cycle derived from Pharaoh's dream in ancient Egypt which is presented in the Old Testament. The solution that was proposed to the forthcoming cycles was to save the surplus of harvest in the first 7 years of abundance and consume the savings in the following 7 years of starvation. Interestingly, the modern economics arrived to this fiscal intervention logic only thousands of years later, as Galbraith writes: *in the late 1930s'*. Nowadays it was rediscovered and developed into a separate widely-analyzed theory which finds strong evidences supporting the correlation between fiscal cycles and output cycles (Benetrix and Lane 2011).

To conclude, undoubtedly the influence of the ancient societies on the modern science is significant and impossible to ignore. The need and desire to predict the future is observable at any stage of the human history, but the methods in which people tried to foresee it – changed. The modern forecasting tools have a considerable influence of the ancient Greek thinkers, while most of the tools to forecast the future used in ancient Egypt and described in the Old Testament are ignored. The current state of economic forecasting relies fully on scientific methods, while the non-scientific ones (dreams, premonition, intuition, religion, magic, etc.) are left as a page of the past.

III. DETERMINANT BIASES IN ECONOMIC FORECASTING

3.1. Economics versus Physics

> *"Economics makes a clear effort to get as close as it can to physics, which is a natural science about "dead" objects; one which is probably closest to predicting the future events."*
>
> *(Tomas Sedlacek)*

While the trajectory of an arrow in physics can be exactly determined knowing certain variables, we can hardly determine the *trajectory* of economics using mathematical models. Models are, in fact, a graphical representation of reality developed under the pretense that they are more explicit and demonstrative than reality itself. The inaccuracy in representation and the impossibility of capturing an image is what makes economics different as compared to physics, harder to understand and predict. Still, seeking that universality of economic theorems can be stimulating in the same fashion that David Orrell (2010) described:

> The beauty of the Pythagorean theorem […] is not that it applies to some right-angled triangles or most right-angled triangles, but to all right-angled triangles. (Orrell 2010, p. 48)

The effort for improving accuracy – this is what makes economics closer to physics, seeking its universality. Regarding the incompleteness of economics, Dr. Subbarao expressed it in an interesting way:

> There is a joke that if something works in practice, economists run to see if it works in theory. (Subbarao 2010, p. 6)

The summarized idea of this is that economics cannot be framed by theory. Focusing on theory only is misleading since not everything can be represented by equations or can be fitted by models. And the effort to provide all theories with empirical support is not exactly what economics as a science should do.

> Rather than attempt to imitate the hard sciences, social scientists would be better off doing what they do best: thinking deeply about what prompts human beings to behave the way they do. (Clarke and Primo 2012, NY Times article)

Economics doesn't work with strictly constant and touchable objects and this is why the theoretical economics has the abstraction and the reality confronted in assumptions:

> A typical statement in economic 'theory' is, 'if information is symmetric, an equilibrium of the game exists' or, 'if people are rational in their expectations in the following sense, buzz, buzz, buzz, then there exists an equilibrium of the economy in which government policy is useless'… Okay, now imagine an alternative set of assumptions… There's nothing deep or surprising about this: **changing your assumptions changes your conclusions**… And on and on and on and on, until the economists get tired and go home… I have expressed admiration for pure mathematics and for Mozart's concertos. Fine. But economics is supposed to be an inquiry into the world, not pure thinking. (McCloskey 2002, p. 43-44)

The real economy is enriched with the characteristic of being *risky*, - an axiom which is "*the cliché of economic life*"[12]. However, it is also uncertain which differs from riskiness not only in terms of independency from our beliefs and knowledge, as Keynes explained in *A Treatise on Probability* (1921), but also the difference consists in the inability of uncertainty measurement with probability dimensions.

The elimination of this insecurity would imply a finished economic activity since, for example, there would be no reason in the existence of the stock markets if there would be no risk in them, or there would be no winners in a horse racing if all knew the winning horse *a priori*. This logic is applicable to the human life also: "*any organism that is too predictable in its behavior will die*" (Orrell 2007, p. 335). And as long as economics is alive, it *should be* unpredictable and far enough from physics.

3.2. Human Behavior Biases

Not even the highest IQ entities have the capacity to foresee the future, as Whitehead (1978) writes: "*it is as true to say that God creates the World, as that the World creates God*". People are those who fear the instability and emotional distress from unanticipations. But the complexity of predicting the future is on an equal measure determined by the unpredictability of human behaviour itself – which started to be regarded in the last period as an important bias when it comes to the decision-making process.

[12] "Nothing is more completely accepted in the conventional wisdom than the cliché that economic life is endlessly and inherently uncertain." Galbraith, *The Affluent Society,* 93.

The incapacity to controlling and modeling it served as one of the motives of the centrally-planned economy collapse, mainly referring to the Soviet Union example (Sedlacek 2011). Modeling human behaviour would mean designing and controlling those *65000 thoughts per day* – an approximated number provided by scientists (Chopra 1990). Although the majority of these thoughts are repeated on a daily basis, each of them has an influential power on the further decisions and, most complicated mathematically, they influence each other.

But not only these subjective and individualistic decisions and thoughts are uncontrollable and unpredictable. The *identity* concept is another explanation developed by Akerlof & Kranton (2000) as determining *a person's sense of self*. One of the main explanations given by the identity concept is the fact that people are consciously subject to choices which can be detrimental to themselves and which affect economic outcomes. Moreover, the identity concept admits that people can harm themselves intentionally *to bolster a sense of self or to salve a diminished self-image* (Akerlof & Kranton 2000, p. 718) – which is catalogued by Sam Harris as a paradox of human life:

> Among the many paradoxes of human life, this is perhaps the most peculiar and consequential: we often behave in ways that are guaranteed to make us unhappy. Many of us spend our lives marching with open eyes toward remorse, regret, guilt, and disappointment. (Harris 2000, p. 4)

A similar idea was developed also by Alchian in 1950. He concluded that human behaviour is unpredictable even if a best-response action is known:

> Uncertainty arises from at least two sources: imperfect foresight and human inability to solve complex problems containing a host of variables even when an optimum is definable. (Alchian 1950, p. 212)

Further two aspects of the human behaviour bias will be discussed: the bounded rationality sustained also by the this-time-is-different syndrome, and the animal spirit bias in parallel with the unbounded emotionality.

3.2.1. This-time-is-different Syndrome and Bounded Rationality

The conventionality of assuming all individuals having identical preferences and, thus, taking identical decisions is widely disapproved and used only in some old models. People are different; they do have different utility functions and different preferences – not always rational and not always the expected ones. Dan Ariely argues that our irrationality is, in fact, predictable since it is not unique, but systematic:

> […] these irrational behaviors of ours are neither random nor senseless. They are systematic, and since we repeat them again and again, predictable. (Ariely 2008, p. XX)

The theory of rationality (which, according to Spohn (2002), has grown as a separate science on its own) assumes that people learn from past mistakes and are able to apply all their abilities in the further decisions, actions knowing that a optimal decision-making requires a prediction of future tastes (Lowenstein et al. 2003).

Nevertheless, the application of the knowledge from past experience in the future decision-making processes is not an easy tool to manage since the distinction between the past experiences and the future ones is, as Adam Smith writes in *The Theory of Moral Sentiments*,

> […] the great source of both the misery and disorders of human life. (Smith 1853, p. 131)

An explanation to the unpredictability problem is the bounded rationality of people who are unable to learn from past mistakes and they let the *this-time-is-different syndrome* to manifest:

> The essence of the this-time-is-different syndrome is simple. It is rooted in the firmly held belief that financial crises are things that happen to other people in other countries at other times; crises do not happen to us, here and now. We are doing things better, we are smarter, we have learnt from past mistakes. [However] the old rules of valuation no longer apply. (Reinhart & Rogoff 2009, p. 15)

Even thought the *this-time-is-different syndrome* explains that learning from past experiences is important, relying on the past only to predict the future can also be erroneous. Experimentally it has been shown that people actually are not able to distinguish between evaluation (*of the past*) and prediction (*of the future*) when they are asked to do so. In both cases they rely on the past experience and the evaluation is equal to the prediction. Such that, as Tversky & Kahneman (1974) argue, if a company's profit has to be evaluated or predicted, the profit amount will be identical for both evaluators and predictors.

However, there is some reasonableness behind people's bounded rationality *in time*. Firstly, we do not have *yet* sufficient "hardware" power to collect and process all the information (but we will be able to do that one day[13]). Secondly, not all information is

[13] "The theories will treat the economy not as an inert machine, but as a kind of living organism. The models and techniques will resemble those developed for life sciences like systems biology or ecology or

worth processing. And the partial ignorance in general is a method to protect our brains from trash info[14]. The bounded rationality can be interpreted as a protective mechanism periodically failing by disregarding relevant information. This selection and/or ignorance can be associated with the omitted variable bias in econometrics – without it the model explains less but how to know which variable exactly is omitted.

Anthony Downs (1957) explained this informational selection using the citizens versus political parties' example where none knows everything about the other but decisions have to be taken: citizens have to choose a party to vote for; politicians have to decide on their priorities in policy-making. Eventually, Downs A. (1957) introduced the *rational ignorance* explaining it as a rational response to the information excess – the processing costs of which can exceed the benefits.

So far, rational ignorance is an explanation to bounded rationality: it is too expensive to know everything. Perhaps, it can also explain the *this-time-is-different syndrome* where the sequential logic is simple: people face an informational selection at an inter-temporal level and ignore the past facts which they believe are ignorable in present. But from the other side, the memory itself is limited and according to the *availability heuristic*[15] the decisions that people are making are based on the memorable experiences only.

To the question why people don't learn from their experience, Adam Smith gives his answer specifying that people are afraid of analyzing their past mistakes and recognizing them[16]. The *self-deceit* is the best summarizing word in this sense: we know about our misconceptions, but we don't like recognizing them.

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medicine. Instead of seeing the economy as a self-contained, closed box, the theories will include interactions." Orrell, *Economyths. Then Ways That Economics Gets it Wrong*, 254-255

[14] "Every society must be protected from a too facile flow of thought. In the field of social comment, a great stream of information novelties, if all were taken seriously, would be disastrous." Galbraith, *The Affluent Society*, 16.

[15] "There are situations in which people assess the frequency of a class or the probability of an event by the ease with which instances or occurrences can be brought to mind. […] This judgmental heuristic is called availability. Availability is a useful clue for assessing frequency or probability, because instances of large classes are usually recalled better and faster than instances of less frequent classes. […] Consequently, the reliance on availability leads to predictable biases." Tversky, Kahneman, *Judgments under uncertainty: Heuristics and biases*, 1127.

[16] "It is so disagreeable to think ill of ourselves, that we often purposely turn away our view from those circumstances which might render that judgment unfavorable." Smith, *The Theory of Moral Sentiments*, 139.

Bounded rationality is, however, not only a problem, but also an argument to explain failures. And there are several (theoretical) explanations to support this intuition.

One of these explanations, developed by Rabin & Schrag (1999), is the evidence of *confirmatory bias* which states that once there is a hypothesis to test, the attention will be paid mostly to those evidences that support it, while those contradicting will be ignored. The disconfirmation itself is already a bounded rationality evidence of an active *irrational* ignorance: reducing the caution, undermining the other experiences, highlighting the self-deceit.

Another explanation of bounded rationality is the *hindsight bias* which is one's tendency, after learning about the actual outcome of a situation or the correct answer to a question, to distort a previous judgment – the prediction – in the direction of this new information (Werthf et al. 2002). The hindsight bias is a re-interpretation of the outcome downgrading the surprise element and adopting of an *"I knew it all along"* attitude (Mazursky & Ofir 1990). Hindsight bias is an attempt to reject any bounded rationality prints. In this sense the old Marxian definition of ideology: "*They do not know it, but they are doing it*" can be reinterpreted according to Jacques Lacan (1997): "*I know it very well, but still, I do it.*"

3.2.2. Animal Spirit Bias and Unbounded Emotionality

As well as bounded rationality, the animal spirit is an involuntary and, additionally, hardly manageable bias.

> […] *It* seems to mean that which motivates us, animates us, somewhat irrationally; that which gives us our aims, hopes, purposes, dreams. It is unpredictable and does not easily lend itself to mathematical analysis. (Sedlacek 2011, p. 276)

The central motivation which drives the humanity, as Adam Smith wrote in *The Theory of Moral Sentiments*, is not hidden in egoism as such, but in craving for social admiration and gratitude. And since these are central drivers which we have the strongest desire for, we end up with sentiments, actions and passions which are over our own control and cold-thinking: we feel like animals "*tormented with all the agonies of doubt and uncertainty*" (Smith 1853, p.142).

But while the bounded rationality and the this-time-is-different syndrome refer to a limited capacity to processing past, present and future events, the animal spirit bias manifests in a continuum present time.

> Most animals seem to focus almost entirely on reacting to current stimuli, as opposed to remembering the past or anticipating the future. We humans are proud that we attend more to the past and future, but perhaps this is still harder than we let on, and we flatter ourselves by thinking we attend more than we do. (Hanson 2011, Online Article on Cato)

Our spontaneity is our animal spirit, and that is a rational explanation why forecasting problems rely on expressions which target animals: black swan, butterfly effect, the well-known trends on the financial markets: bear and bull, or the monetary policy phenomenon of hawk and dove.

The power of our sentiments, beliefs, and emotions is uncontrollably over the power of classical rules, judgments and even rationality. And the uncontrollability of this power gives us an animal spirit which takes the decisions on our behalf. The main reasoning behind the manifest of such a bias, according to Martin et al. (1998), is people's inability to bound emotions – which increased into a separate theory: bounded emotionality according to which people have to learn to limit their emotiveness, at least in some cases, in order to be considered adapted humans. The most relevant example in this sense is people's behaviour at work which has to be more reserved and calculated, less eccentric and wild. Thus, while bounded rationality is non-voluntary, the emotionality is to be bounded intentionally.

3.3. Types of Scientific Predictions

The punishment which people can get from trying to discover the future cannot be worse than unpredicted events to occur. The justification for a misleading forecast can rely on any of the described biases, in the economists' limited professionalism, in the models bounded capacity. Accurate or ambiguous, forecasting is

> […] the oldest dream of humanity, the dream to know what the future has in store for us, and to profit from such knowledge. (Popper 1959, p. 4)

If it is our oldest dream, we cannot argue about its morality per se, it is just something in us, our defining treat. But is it all *forecastable*?

Karl Popper makes a clear line in this sense: not everything is predictable, and scientists should learn to distinguish between the conditional and unconditional forecasting.

3.3.1. Conditional Forecasting

The conditional scientific prediction, according to Popper (1959), is a deductable prediction and can be regarded as a response to certain excitations (if X happens, Y will happen), while the unconditional one is just an a priori post-factum (Y will happen). The incapacity of people to distinguish between these two types of forecasting is an explanation to predictions' accuracy failures.

The conditional forecasting is presented by Karl Popper as a *scientific prediction* or a prediction which is affordable to the scientists. However, not even the conditional predictions are universally understandable since they have time constraints:

> […] long term prophecies can be derived from scientific conditional predictions only if they apply to systems which can be described as well isolated, stationary, and recurrent. (Popper 1959, p. 5)

Even though the modern times are neither stationary, nor isolated, Karl Marx believed that it is only a stationary and closed society (with no foreign trade[17]) the one universally and conditionally predictable.

In Marxian interpretation the unconditional events (e.g. crises) appear only as a disturbance to the economic system artificially excited by the wealthiest class in the society (bourgeois).[18] Galbraith also mentions in *The Affluent Society* that for Marx, depressions are a devastating fact of capitalist life which aims the destruction of the whole system – where destruction means centrally uncontrollable or, as translated into economic terms: high volatility systems.

Conditional forecasting, thus, is an affordable forecasting given specific conditions. However, economics is far from being perfectly conditional.

3.3.2. Unconditional Forecasting

As already mentioned, the unconditional forecasting is a future fact which cannot be predicted. It is a *historical prophecy* (Popper, 1959) which scientists try to predict and

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[17] "What he [*Marx*] had hitherto deduced […] that the world trade crisis of 1847 had been the true mother of the February and March revolutions." Engels, *Introduction to Karl Marx's. The Class Struggles in France 1848 to 1850*, 2.

[18] "Constant revolutionizing of production, uninterrupted disturbance of all social conditions, everlasting uncertainty and agitation distinguish the bourgeois epoch from all earlier ones." Marx, *Manifesto of The Communist Party,* 16.

fail to differentiate from a scientific prediction. Scientific forecasting requires scientific arguments. Unconditional forecasting can rely only on non-scientific arguments such as intuition, dreams, premonition etc. – transforming the unconditional forecasting into unconditional prophecy which is scientifically insignificant. However, even the *assumptions* on which the econometric models are based are far from being strongly scientific, credible and undeniable. The unconditional forecasting does not rely practically on any assumptions and its prediction can be considered as universal ones, applying to all models. For example:

> […] if the Fed's staff would compute an unconditional best forecast for the federal funds rate it might as well dominate the model forecasts for all horizons. (Wolters 2011, p. 19)

From the technical point of view, the difference between the conditional and unconditional forecasting models is that the first ones use structural models, while the former – the non-structural models which

> […] attempt to exploit the reduced-form correlations, with little reliance on economic theory. Structural models, in contrast, view and interpret economic data through the lens of a particular economic theory. (Diebold 1998, p. 175)

The tradeoff between conditional and unconditional forecasting becomes clear enough. The conditional one limits you to tight boundaries but gives you a plausible outcome; while the unconditional forecasting has no limits and has perfect answers which just are neither definable, nor scientifically understandable.

3.4. Conventionalism and Statistical Significance

> *"In 1940s and 1950s, economists sought philosophical justification for their practice of model and measure. Nowadays, the focus is on conventionalism." (Pette Boettke)*

Statistics is a conventional science working in certain frames, methodologies, based on certain assumptions. If the assumption is wrong, the whole mechanism is useless regardless of the result significance. However, neither statistics, nor mathematics is a sin of economics – both are virtues, according to McCloskey (2002).

The conventionalism roots state that there is no science which is unambiguously determined by experience only, economics is no exception. Therefore, scientists have to choose among a wide range of theories and methodologies. Conventionalism states that the simplest one will be chosen. The *simplest one* means, as Popper (1959) classifies it,

something closer to *partly practical*, closer to partly true. Accordingly, if economics is a conventional science, then it doesn't incorporate in itself the entire information about the economic processes but chooses the simplest one by quantifying them (expressing numerically).

Statistical significance comes next to help in falsification, which is considered as a separate twentieth-century story, according to Blaug writings (1997). The reason why statistical significance is directly linked to falsification is because it is a qualitative measure of probability about the data assuming the truth of a singular hypothesis (McCloskey 2002), such that all others are rejected.

As R. Fisher wrote in his famous article introducing the statistical significance, *Statistical Methods for Research Workers* (1925):

> […] the science of statistics is essentially a branch of Applied Mathematics and may be regarded as mathematics applied to observational data. (Fisher 1925, p. 3)

However, by the virtue of its creation, economic thought has to be much more expended that some applied mathematics alone. Fisher (1956) himself pointed, after introducing the statistical significance the following:

> However, the calculation [of the statistical significance] is absurdly academic, for in fact no scientific worker has a fixed level of significance at which from year to year, and in all circumstances, he rejects hypotheses; he rather gives his mind to each particular case in the light of his evidence and his ideas. (Fisher 1956, p. 7)

And even tough Fisher himself pointed one of the main weaknesses of the overemphasis and non-universality of the statistical significance he made a mistake which is not sufficiently covered not even today. It concerns mainly that, as Curran-Everett stated (2009), Fisher defined a null hypothesis but no alternative hypothesis and considered only this hypothesis relevant, ignoring that there can be other extended, mixed ones:

> Every experiment may be said to exist only in order to give the facts a chance of disapproving the null hypothesis. (Fisher 1937, p. 17)

To this has to be added that when we make an inference about a null hypothesis, we can make a mistake by rejecting a true hypothesis or failing to reject a false hypothesis both involving an error[19]. Milton Friedman explains that,

> […] the validity of a hypothesis […] is not by itself a sufficient criterion for choosing among alternative hypotheses. Observed facts are necessarily finite in number; possible hypotheses, infinite. (Friedman 1966, p. 9)

But either rejected or not what the significance test reveals is whether there is anything non-random that describes the analyzed regression and which is important. The answer can be either yes-or-no, while science, according to Currant-Everett (2009), is less yes-or-no and more how-much. Or, as Galbraith (1960) expressed it: "*A possibility of a trouble is not a prediction of a trouble".*

In this way we risk to exclude the relevancy out of the model by excluding random events. However, conventionality claims that this simplification is sufficient enough.

What could be a strong excuse for the social sciences to explain the models' inaccuracy is to stick to the Friedman's (1966) *instrumentalism theory*. Accordingly, positive economics is concerned with the development of a theory of hypothesis which would yield valid and meaningful predictions. And, by definition, positive economics should provide generalizations, while the assumptions on which the positive economic theories are based are not realistic and cannot be and, thus, the results are not defined by descriptive accuracy but analytical relevancy.

> Complete "realism" is clearly unattainable, and the question whether a theory is realistic "enough" can be settled only by seeing whether it yields predictions that are good enough for the purpose in hand or that are better than predictions from alternative theories. (Friedman 1966, p. 41)

3.5. Nowcasting

Economic prediction does not mean solely prediction of the future. The nowcasting is a new economic methodology, a set of standard measures to assess the present state of the economy. Nowcasts represent the current-quarter forecasts, mostly used by monetary

[19] "There is a profound asymmetry between conclusions issuing from rejecting the null hypothesis on the one hand, and failing to reject it on the other. Somewhat ironically, the main reason for this asymmetry is that, as noted, accepting the null hypothesis is almost always a guaranteed error." Loftus, *On the Tyranny of Hypothesis Testing in the Social Science*, 104.

institutions, according to which nowcasting represents the prediction of the present, the very near future and the very recent past (Banbura et al. 2010).

Unlike, for example, weather where forecasters know perfectly what was the weather yesterday and what weather is exactly at this moment, economics faces a time-struggle with data collection and even *forecasting* the very recent past and present is a dilemma.

The methodological tool which stays at the bottom of nowcasting procedure was developed by Giaconne et al. (2008) and it mainly represents a non-standard tool that exploits the information in a large number of monthly variables, released in an asynchronous way. The nowcasts, thus, are being updated each time when new information is introduced into the dataset which becomes progressively larger in time. The idea of this all-info-inclusiveness methodology is in contrast with the conventionalism idea since it captures all information available on the market. And even though the nowcasts are not perfectly accurate, they are evaluated as being more accurate than the low-information models.

The basic idea of the nowcasting methodology can be summarized as *the more we know – the more we know*, where, as its authors, Giaconne et al. (2008), suggest, the timing of releases is a key determinant of the size of the release's marginal predictive power.

Along with nowcasting, the issues related to data revisions have to be also mentioned. Most economic variables with few exceptions (*e.g. interest rates, exchange rates, commodity prices and survey of forecasts*[20]) are systematically revised. This is either related to data collection issues, certain post adjustments or redefinitions. Either way, at least for the 3 most important economic variables: GDP, unemployment rate and CPI, the Federal Reserve is revising the data even 5 years after the initial release (Table 3.1.).

This leads to a rational conclusion that even in a 4-year old data might be hidden an error due to methodological and practical inability to measure instantaneously the economy. The revision itself tends to improve the quality of data, however, adding more uncertainty into it. And the main implication, according to Cardoso & Duarte (2009), is not even the inaccuracy in the performed economic analysis based on inaccurate data, but the policy implications which may alter current assessments.

[20] Cardoso & Duarte, *Data revisions*, 2

Table 3.1: Timing and Reasons for Data Revisions

Data Series (*Reporting Agency*)	**Timing of Revisions**	**Reason for Revisions**
National Income and Product Accounts Data – includes real GDP and the GDP price index (*Bureau of Economic Analysis*)	1 month after initial release	More complete information
	2 months after initial release	More complete information
	Every July the prior 3 years of data are revised	Better, less timely information becomes available
	All historical data are revised every 5 years or so (benchmark revisions)	New source data, possible changes in definitions of variables or in methodology
Unemployment Rate (*Bureau of Labor Statistics*)	Occasional	With changes in census population (usually, but not always, associated with the decennial census)
	For 5 years after initial release	Seasonal adjustment factors are revised with the availability of additional data
Consumer Price Index (*Bureau of Labor Statistics*)	Occasional	To correct reporting errors or software errors
	For 5 years after initial release	Seasonal adjustment factors are revised with the availability of additional data

Source: Kozinski, 2004

The biggest issue concerning data revisions is not caused by the revisions existence themselves, but by the unpredictability of the adjustments which strongly rely on news updates. Moreover, revisions are not even persistent and are labeled as "badly-behaved" information (Cardoso & Duarte 2009), with a non-zero mean.

The lesson to be learnt from nowcasting, thus, is the fact that not only the far future is unknown to the economists but also the relatively recent past. And, probably, predicting the past is even a bigger challenge to the economists than foreseeing the future.

IV. EVALUATING FORECASTING PERFORMANCE DIFFERENCES BETWEEN DEVELOPED AND DEVELOPING COUNTRIES

One of the main differences which are implied when tracing a line between developed and developing countries is institutional performance[21]. However, the performance of those institutions is strongly influenced and dependant on the credibility and correctitude of the available data. Policy makers are daily using in their work forecasts on which they base they decisions. Quite simply, good forecasts lead to good decisions (Diebold & Lopez 1996). Or, the value of the forecasts made can be best understood in the relation to the decisions guided by the respective forecasts (Elliott & Timmermann 2008).

In this part of the thesis, an analysis of the accuracy of the forecasts performed by the International Monetary Fund will be done. Firstly, the IMF as a data provider will be introduced and its credibility in this sense will be discussed. Secondly, the evaluation of the forecasting performance of the IMF on the developed versus developing countries will be done in order to test whether the precision of forecasts is higher for the rich countries as compared to the least developed ones.

4.1. International Monetary Fund as a Data Provider

IMF appears as one of the most credible international institutions. This is sustained by the increased popularity of the "precautionary programs", as well as the built-in image of the organization as an aid agent with well-structured regulatory requirements and as a purveyor of policy advice (Bordo & James 2000).

The IMF credibility is primarily enforced by the strong conditionality which is defined as a tool by which a country is made to follow specific policies or to undertake certain reforms that it would probably not have undertaken otherwise, in exchange for support

[21] "While the definitions of "institutions" may vary across studies, the results are consistent and strong: institutions explain economically and statistically significant differences in per capita incomes across countries." Eicher & Leukert, *Institutions and Economic Performance*, 7.

(Buira 2002). Secondly, the credibility is enforced by the IMF programs contribution to economic development in the countries that were subject to respective programs which is widely supported and analyzed (Haque & Khan 1988; Krueger 1998; Przeworski & Vreeland 2000; Shirai 2003; Dreher & Walter 2008; etc.)

As it is argued, one of the IMF's most useful functions to the debate about policy coordination is through the provision of data and forecasts (Bordo & James 2000). Nowadays the World Economic Outlook is one of the most widely accessed databases. There are at least two reasons behind the popularity of the IMF databases:

1. Availability of an aggregate cross-country dataset;
2. High data credibility given that IMF imposes penalties on the local governments for the supply of the misleading data.

Taking these into account, IMF seems one of the most reliable and credible data sources for the comparison of the forecasting performance between developed and developing countries. This is why the further empirical research will be based on it.

4.2. What is Easier to Forecast?

According to the hypothesis, the economic forecasts provided by the IMF are more accurate in the developed countries comparing to the developing ones. The interpretation of the forecasting accuracy can be regarded as an indicator of the statistical institutions performance for country-groups.

The rationale behind this hypothesis lies in the predictability of the development path of developed countries versus the developing ones. The low-income countries are, generally, assumed to have a more volatile path of growth, making the economic variables to be hardly predictable, while the growth itself is not sustainable, but rather sporadic (Anbarci, Hill & Kirmanoglu 2011). The unpredictability and high volatility is not only a weak economy indicator, but also represents a negative externality given that policies and decisions are based on erroneous predictions (Mobarak 2005). A survey conducted by Harris International in 2006 showed that about 75% of the wrong business decisions are taken because of the erroneous data.

Koren and Tenreyro (2007) formulated three justification of a high volatility in the developing countries:

(i) Poor countries are specialized in fewer and more volatile sectors;

(ii) Poor countries experience more severe and more frequent aggregate shocks;

(iii) Poor countries' macroeconomic fluctuations are more highly correlated with the shocks affecting the sectors they specialize in.

Taking these supportive arguments into account, the hypothesis that is to be analyzed is: *IMF economic forecasts are more accurate in the developed countries comparing to the developing ones*.

4.3. Description of the Dataset

The hypothesis will be tested on a dataset of 15 developed countries and 15 developing countries (Table 4.1), World Economic Outlook (IMF) being the primary and only source of data.

Table 4.1: Dataset Country-List

Developed Countries	Developing Countries
Austria	Armenia
Belgium	Albania
Denmark	Belarus
Finland	Bulgaria
France	Estonia
Germany	Georgia
Italy	Hungary
Luxembourg	Latvia
Netherlands	Lithuania
Norway	Moldova
Portugal	Poland
Spain	Romania
Sweden	Russia
Switzerland	Turkey
United Kingdom	Ukraine

The panel data includes 4 economic variables. Two of them are actual values for: the percentage change in the Gross Domestic Product in current prices (actual GDP growth rate) and the percentage change of inflation, average consumer prices (actual inflation rate). The values for these variables are taken from the next-year reports (e.g. the GDP growth in Luxembourg for the year 2007 was 5.336% as mentioned in the World Economic Outlook from April 2008).

The other two variables represent forecasted values: forecasted GDP growth rate and forecasted inflation rate. Their values are taken from the one-year-before reports (e.g. the forecasted GDP growth in Luxembourg for the year 2007 was 3.8% as mentioned in the WEO from April 2006).

The dataset has 22 time-periods, covering the years 2000 to 2010[22] on a semiannual basis, such that the dataset includes all forecasting adjustments as well as the actual data updates every 6 months (e.g. the actual GDP growth in Luxembourg for the year 2007 was 5.336% as mentioned in the WEO report from April 2008, while the same variable for the same country and same year provided in the following WEO report from October 2008 was updated to 4.475%). Respectively there are two sets of information generated in the same year: April and September/October.

It is worth mentioning that the actual data that will be used in the analysis is rather a *nowcasted* data than an actual one since it doesn't incorporate the very last update of the respective variable but reflects only the 1-year after value which can be and usually is subject to change. This, however, allows having a dataset with symmetric variables in terms of time, since forecasts and nowcasts are available one-year before and one-year after the observed period.

4.4. Methodology Description

In order to test the hypothesis six distinctive forecasting performance measures will be used. All of them describe the inaccuracy of the performed forecasts, such that the greater their value is, the more erroneousness the forecast is as comparing to the actual value. All of these measures are meaningless if computed independently such that for relevancy there should be at least two points of comparison. The comparison in our case will be done between the developed and developing countries, trying assessing for which the forecasted data is more accurate.

Important to mention, there are two different errors which are calculated yearly based on the next-year data $y_{t,t+1}^{April}$ and $y_{t,t+1}^{Sept}$ from which the one-year-before forecast is subtracted $\hat{y}_{t,t-1}^{April}$ and $\hat{y}_{t,t-1}^{Sept}$. Such that:

[22] The forecasts are taken from the WEO reports in the period 1999 to 2009, whilst the actual data are taken from the next-year-reports: 2001 to 2011.

April absolute forecast error in year t

$$e_t^{April} = y_{t,t+1}^{April} - \hat{y}_{t,t-1}^{April} \quad \textbf{4.4.1}$$

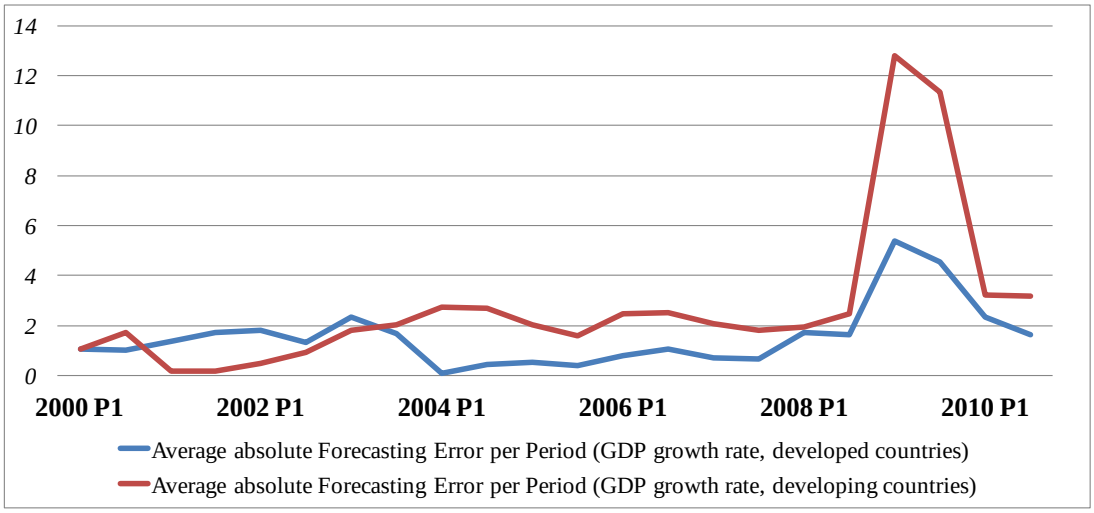
September absolute forecast error in year t

$$e_t^{Sept} = y_{t,t+1}^{Sept} - \hat{y}_{t,t-1}^{Sept} \quad \textbf{4.4.2}$$

At this stage, the contrast between developed and developing countries forecasting performance can be represented in a time evolution of the respective errors, where a null error indicates a perfect forecast.

In the Figure 4.1 is represented the evolution in time of the average absolute forecasting error for the GDP growth rate. Visibly, the developed countries were outperforming the developing ones since 2003. As it should be expected, the errors were significantly higher during the financial crisis for both groups of countries, being expressed in high error values starting with the end of the 2008th year.

Figure 4.1: Average Absolute Forecasting Error of GDP Growth Rate

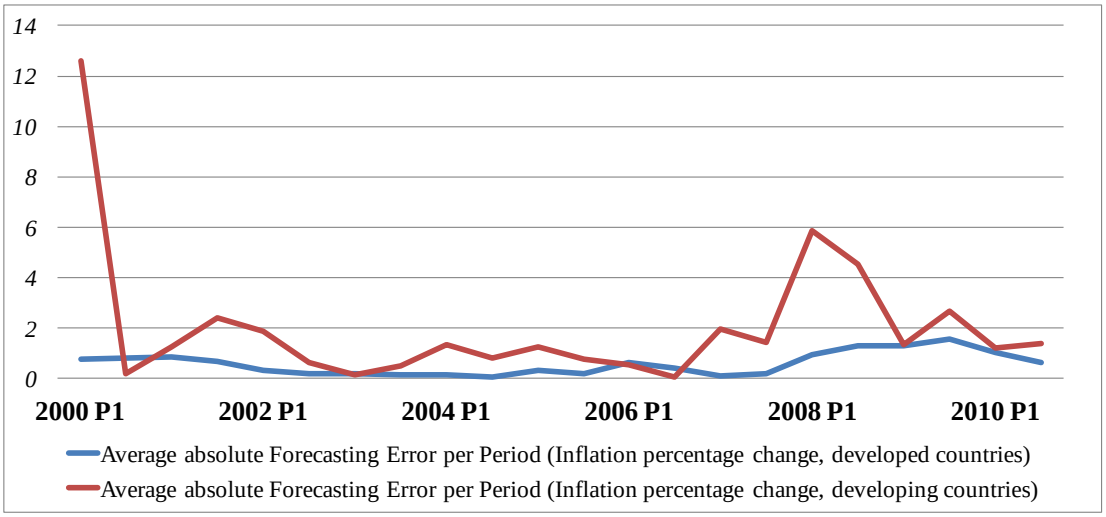


Source: Author's computation

As well as the plot for GDP growth rate errors, the one for inflation percentage change errors (Figure 4.2) shows a slightly smoother difference between the errors, with the exception of the beginning of the year 2000, when developing countries considerably under-forecasted the actual inflation rate.

But even with a less notable difference between the errors, the developing countries seem to be on average above the developed countries errors-line, which reveals that the forecasted inflation rate was more accurate for the rich countries as compared to the developing ones.

Figure 4.2: Average Absolute Forecasting Error of Inflation



Source: Author's computation

The plotted average absolute forecasting errors for both GDP growth rate and inflation rate show that the developed countries are on average outperforming the developing ones. Further several analytical tools will be applied in order to test this evidence and to give a quantitative justification on which the final conclusion on the comparative performance of the analyzed groups of countries will be based.

All forecasting performance measures that will be further introduced are computed based on the forecast error: e_t on a semiannual basis.

4.4.1. Mean Squared Error

Mean Squared Error or Mean Squared Deviation is one of the most widely used methods to evaluate forecasting performance. The higher the MSE is, the less accurate is the forecast and the more it deviates from the value of the actual variable.

Even though the measure succeeds to include all the observations in the result it gives, it is negatively influenced by the outliers that can cause a deviation from a *true* MSE value. However, there is no correct or incorrect value that MSE should take, however a lower MSE value is always preferred over a higher one.

$$MSE = \frac{1}{n} \times \sum_{t=1}^{n} u_t^2 \qquad \textbf{4.4.3}$$

4.4.2. Root-Mean Squared Error

RMSE is a measure based on the MSE, practically being the square root of it. And as well as MSE, RMSE penalizes more the large errors, such that outliers have a significant influence on the final result.

However, if the MSE gives the result measured in the squared average error units, RMSE gives directly the size of the average error being expressed in the same scale as the analyzed data.

$$RMSE = \sqrt{\frac{1}{n} \times \sum_{t=1}^{n} u_t^2} = \sqrt{MSE} \qquad \textbf{4.4.4}$$

4.4.3. Mean Absolute Percentage Error

MAPE shows the inaccuracy of the forecasted data which is expressed preferably in a ratio-scale (Ahlburg 1992), as it is in our case. However there are four computational problems that determine it (Makridakis 1993):

1. Equal errors above the actual value result in a greater APE than those below the actual value, which is an asymmetry problem;
2. Extremely large percentage errors are to be expected with small values of the dataset (usually less than 1);
3. The outliers can excite also extremely large errors which distort the comparison;
4. MAPE is not comparable with other measures.

$$MAPE = \frac{1}{n} \times \sum_{t=1}^{n} |u_t / y_t| \qquad \textbf{4.4.5}$$

4.4.4. Mean Absolute Deviation

MAD is known for the correction of the *cancelling out effect*, such that the average of errors are done on their absolute values, by that keeping the influence of all deviations at a same level, independently on their sign.

$$MAD = \frac{1}{n} \times \sum_{t=1}^{n} |u_t| \qquad \textbf{4.4.6}$$

4.4.5. Largest Absolute Deviation

LAD is a measure that shows the most aggressive outlier-error in its absolute value. It is perhaps irrelevant to use only this measure independently to conclude on the overall forecasting performance. But in combination with the other measures it contributes to a more comprehensive conclusion on the overall performance.

$$LAD = \max |u_t| \qquad \textbf{4.4.7}$$

4.4.6. Median Absolute Error

The advantage of using MeAE is its unaffectedness by outliers, however it doesn't take into account all observations, thus why MeAE, as well as LAD, should be used only in combination with some other measures to be more reliable.

$$MeAE = median|u_t| \qquad \textbf{4.4.8}$$

4.5. Interpretation of the Results

After applying the above mentioned forecasting accuracy evaluation measures on the GDP growth rate and inflation percentage change for the developed and respectively developing countries, the following results were obtained:

Table 4.2: Forecasting Performance Evaluation Output

	Developed Countries		*Developing Countries*	
	GDP g.r.	Inflation p.c.	GDP g.r.	Inflation p.c.
MSE	5.0239	1.1469	**27.7003**	**141.1347**
RMSE	2.2414	1.0709	**5.2631**	**11.8800**
MAPE	**3.0418**	1.7635	0.9537	**9.9884**
MAD	1.6444	0.8041	**3.4771**	**4.6001**
LAD	9.8710	4.7000	**22.4230**	**139.0000**
MeAE	1.1050	0.6295	**2.1660**	**2.3065**

Source: Author's computations in Excel

According to the outcome from Table 4.2, the forecasting performance of the inflation percentage change is strictly more accurate in the developed countries as compared to the developing ones (the error measures are strictly higher), which is in line with the output of all six measures that were calculated.

When it comes to GDP growth rate the same conclusion holds with the exception of one measure that shows a counter-intuitive result. The Mean Absolute Percentage Error indicates that developing countries' forecasts are more accurate:

$$304.18\%_{(developed)} > 95.37\%_{(developing)}$$

One of the explications of this result can be the impact of the outliers which tend to cause overinflated results. This problem can be corrected by deleting outliers from the dataset and obtaining a non-biased measure. However, this approach is not recommended by Makridakis (1993) who points that, especially in economics, outliers are costly and undesirable but they must be known to the decision-makers as they drive the data.

Moreover, as mentioned previously, the original dataset small values can spoil the MAPE result by inflating it. If comparing the number of GDP growth rates below one unit for the observed group of countries, the following distinction can be seen: out of 330 observations, developed countries have 60 observations contained in the $[0, 1]$ interval in their absolute value, while for the developing countries this number is about six times lower: 9 observations only contained in the interval $[0, 1]$. Partially, this justification explains the MAPE result and its biasness since small values dataset usually generates larger error values than large values dataset does.

However, out of six measures of forecasting performance five show that the developed countries forecast-errors for the GDP growth rate are lower than those of the developing countries. This is a strong argument to state that the forecasts of the respective variable for the developed countries are more accurate than for the developing countries.

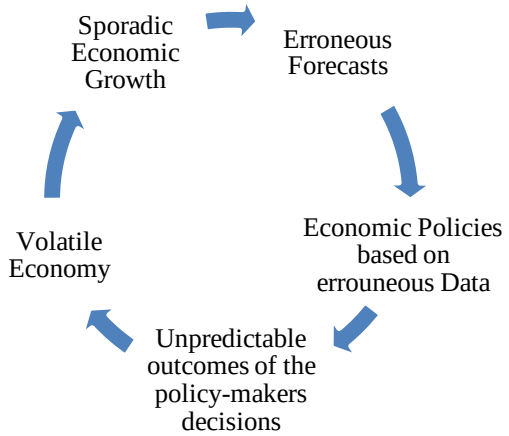
Consequently, we can conclude on the example of a two group of countries (developed and developing ones) that the level of development of the country (whether it is developed or developing) is directly and positively correlated with the credibility and accuracy of the forecasts. This has been shown on the example of the GDP growth rate and inflation percentage change.

The main implication of this result is that developing countries are struggling with the *misleading data trap* (Figure 4.3). The misleading forecasts on which developing countries rely (and which are more erroneous than the developed countries forecasts) are an additional factor causing policies to be less efficient. As has been mentioned, the good decisions and policies are directly and strongly correlated with the quality of the data which the policy-makers are operating with. Based on 6 forecasting evaluation measures it has been shown that the developing countries are provided by the IMF with a more erroneous set of forecasts as compared to the developed countries. This can lead to the following set of harmful consequences:

(i) Finance-related impact (lower revenues, overestimated expenses, etc.);
(ii) Risk-related impact (investment risk, competitiveness risk, corruption, etc.);
(iii) Productivity-related impact (delayed decisions, decreased quality, etc.);
(iv) Confidence-related impact (credibility and reputation issues, etc.).

Additionally, in the vast majority of cases forecasts are based on the assumption that economic policies will not change during the forecast period (Masi 1996), which is not always the case. And, inversely, the economic policies and decisions are based on the strong assumption that the forecasts will not deviate significantly.

Figure 4.3: Misleading Data Trap in Developing Countries



Source: Author's representation

Consequently, it is not only the volatile economy what causes misleading forecasts in the developing countries, but the poor data quality itself is a factor catching and maintaining the country in its under-developed level since policy-makers rely in the decision making process on some erroneous data about the future state of the economy. Accordingly, the country is caught in a poor data quality trap.

V. THE OPTIMISM BIAS ANALYSIS IN IMF FORECASTS

"Indeed, markets rely for their existence on emotions."

(David Orrell)

5.1. Defining Optimism Bias

The relatively recent discipline, behavioral economics, has identified that human decision-makers exhibit a number of systematic biases observed in reality, as well as in the lab experiments (Keith et al. 2006). The impartiality of the people in the decision-making processes is, however, not a recent subject. It has been also discussed in details in the Adam Smith's book, *The Theory of Moral Sentiments.* Smith referred to the subject of rationality versus emotionality, introducing the idea of an *impartial spectator* as a judge of our conduct who can be no other person than us, ourselves.

However, our views are apt to be subjective, and are so when it is the most important to be otherwise (Smith 1853). But even with recognized impartiality, the level of the self-overconfidence is significant. This *problem* is not negligible especially in policy-making where, according to Angner (2006), only institutional constraints can increase the accountability.

Furthermore, not only an overconfident behavior is a significant guiding bias, but also the propensity to use affect for judgment is even stronger as people get older, as the research conducted by Weierich et al. (2011) found. Thus, the more experienced economists are, the more they use their own opinion and intuition rather than the objective knowledge: which we do not necessarily highlight as a disadvantage for the outcomes of their work.

Generally, the use of emotiveness to make predictions is a natural expression of the human state. The economic predictions are not an exception. The bias which is of particular interest in this work is the optimism bias.

The optimism (or optimistic) bias introduces the mistaken belief that one's chances of experiencing a negative event are lower than those of one's pears, while the chances of experiencing a positive event are higher. The optimism bias is a theory formulated in

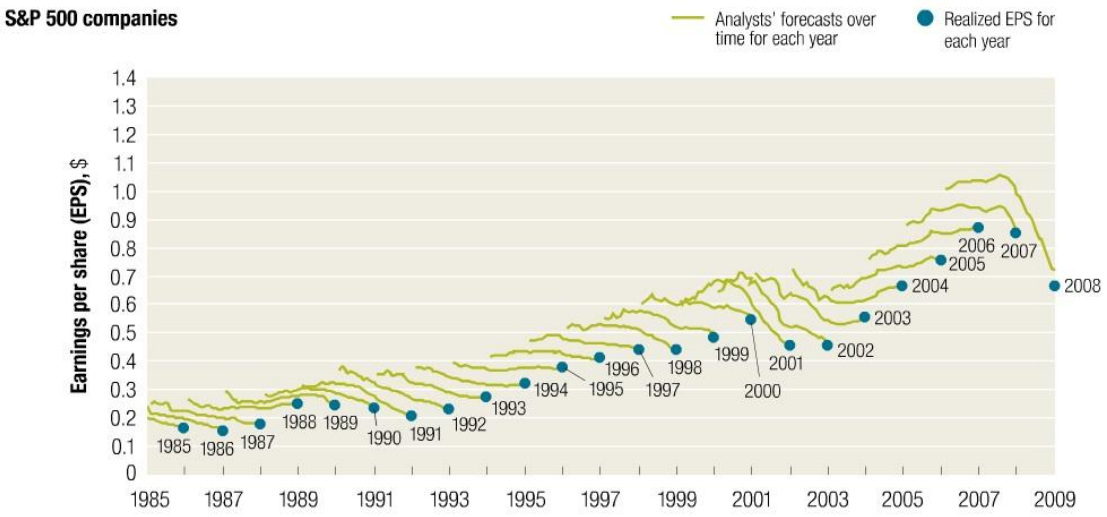
1980 by Weinstein Neil and is also known as *unrealistic optimism*, *positivity illusion*, *illusion of unique invulnerability* or *personal fable*.

The practical realization of the optimistic bias would be reflected in a situation in which the majority of the individuals in a group are above the group average, which cannot be true, thus, as Klein (2006) argues, optimism bias is a bias at the level of the group.

And even if the name *bias* is interpreted with a negative meaning (at least in econometrics), the optimistic bias itself is not always a bad thing to happen. As pointed by Ariely (2009), without an optimistic bias, people would be very risk averse: there would be much less start-ups, businesses, fewer sectors explored, fewer investments. Without an optimistic bias consumers would consume less and producers would produce less by that smoothening and slowing down the economic development and growth.

However, optimistic bias is one of the reasons of forecasting inaccuracy and, as it has been shown in McKinsey Quarterly from April 2010 (Figure 5.1), the optimism bias can be observed in the updated forecasts for the earnings per share, where the exceptions to the long pattern of excessively optimistic forecasts are rare.

Figure 5.1: Optimism Bias on S&P 500 companies EPS Forecast Update

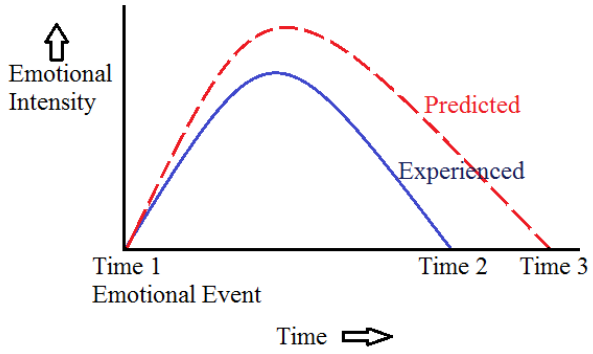


Source: Thomson Reuters I/B/E/S Global Aggregates; McKinsey Analysis

Besides the optimistic bias which has an implication on the economic forecasting and is to be further tested, there is also known the affective forecasting bias – a social phenomenon developed by two Harvard professors, Wilson T. & D. Gilbert (2005). They

have introduced the *affective forecasting*[23], providing a partially contrary prediction than the optimism bias does. Both concepts suggest an overprediction of the positive-meaning variables, but they diverge in predictions for the negative-meaning variables.

Figure 5.2: Affective Forecasting Representation



Source: Wilson T. & D. Gilbert, 2005

While optimism bias suggests that negative-meaning variables will be on average underpredicted, the affective forecasting suggests overprediction relying on the people's tendency to exaggerate perception about the future in all situations.

In our research we test the hypotheses of optimistic bias presence in the IMF forecasts for GDP growth rate and inflation rate. The hypotheses will be tested based on the IMF, World Economic Outlook dataset, as already described in Chapter IV, 4.3. The positive-meaning variable to be analyzed will be GDP growth rate, whilst the negative-meaning variable: inflation rate. Respectively, the summarized hypotheses are the following:

I. IMF forecasts for the GDP growth rate are on average overestimated comparing to actual ex post values;

II. IMF forecasts for the inflation rate are on average underestimated comparing to actual ex post values.

The econometric analysis is performed in STATA and GRETL software.

[23] "Research on affective forecasting has shown that people routinely mispredict how much pleasure or displeasure future events will bring. […] More common than underestimating future emotional reactions, […] people overestimate the intensity and duration of their emotional reactions to future events." Wilson, Gilbert, *Affective Forecasting. Knowing What to Want*, 2.

5.2. Testing Optimism Bias on GDP growth rate forecasts

The overprediction in the GDP growth rate forecasts by the IMF has been already captured by many economists suggesting that forecasts are on average higher than the actual data. But this result is not consistent over all analyses.

Timmermann (2006) analyzed the IMF forecasts for 178 countries for the period 1990-2003 and concluded that WEO forecasts for real GDP growth display a tendency for systematic, persistent over time overprediction. Julio and Esperança (2012) evaluated the quality of OECD and IMF forecasts for GDP growth rate between 1994 and 2010 for the G7 countries and concluded on the presence of overprediction which is caused primarily, according to their results, by overpredictions in investments and net exports.

Takagi and Kucur (2006) conducted an analysis of the IMF's GDP growth rate forecasts during 1994–2003 (on 107 countries), the results suggesting a heterogeneous forecasting performance across regions: optimism in Africa and Latin America, pessimism in industrial countries and the Middle East, and lack of systematic bias in emerging Asia and transition countries. The authors found that optimism bias is more characteristic to the countries benefiting directly from IMF programs.

The empirical analysis that will be further conducted will be focused on the recent data covering the period between 2000 to 2010[24]. The available panel dataset is strongly balanced which reflects that all countries have the data for all observed years.

Table 5.1: GDP Growth Rate Statistics Description

Variable		Mean	Std. Dev.	Min	Max	Observations	
fc_gdp	overall	3.342667	2.040226	-4	10	N =	660
	between		1.338859	1.676455	6.185	n =	30
	within		1.557915	-5.333288	7.813349	T =	22
act_gdp	overall	3.084665	4.385921	-18.016	13.9	N =	660
	between		1.925832	.4754545	7.854727	n =	30
	within		3.955459	-19.19306	10.9628	T =	22

Source: Author's computations in STATA

As can be noticed from the descriptive statistics in Table 5.1, there are 660 observations for 30 countries over 22 periods (11 years, 2000-2010, on a semiannual basis). The data

[24] The forecasts are taken from the WEO reports in the period 1999 to 2009, whilst the actual data are taken from the next-year-reports: 2001 to 2011.

shows that the forecasted GDP growth mean is higher than the mean of the actual one-year-after value. However, the overprediction itself will be further analyzed using some more technical-analytical methods.

The descriptive statistics also captured the two types of variability in the data: **within** (among the data for particular country) and **between** (the variability between countries). Both of them are higher for the actual data of GDP growth suggesting that forecasts are usually smoother, with a stronger mean than the actual data.

The empirical model to be further tested is represented in the (5.2.1) equation. And it will be regressed using four different models for panel data (Pooled OLS, LSDV, FE and RE):

$$g_{i,t,t+1} = \alpha_0 + \alpha_1 \times g_{i,t,t-1} + \varepsilon_{i,t} \qquad \textbf{5.2.1}$$

In this model $g_{i,t,t+1}$ stands for the next-year (actual) data for GDP growth rate, while $g_{i,t,t-1}$ reflects the one-year-before forecast. The indices are to be interpreted as follows: the first one is a country index ($i = 1, 2 \dots 30$); the second index stands for the 22 observed time-series ($t = 2000{:}1, 2000{:}2, \dots, 2010{:}2$); whilst the third index stands for the year in which the data for (t) was released: (t+1) standing for the one-year-after actual data, (t-1) – one-year-before forecast.

The equation (5.2.1) is a one-way-error-component model, in which the error term is composed of a country specific, time invariant component (ε_i) and a reminder disturbance term ($v_{i,t}$), as presented in the equation (5.2.2).

$$\varepsilon_{i,t} = \varepsilon_i + v_{i,t} \qquad \textbf{5.2.2}$$

Respectively, the initial model can be rewritten as:

$$g_{i,t,t+1} = \alpha_0 + \alpha_1 \times g_{i,t,t-1} + \varepsilon_i + v_{i,t} \qquad \textbf{5.2.3}$$

After performing all necessary tests and deriving the correct model and coefficients for the above presented regression, the following two tests will be used for identifying the presence of the optimism bias in the IMF forecasts:

(i) **Test for the Efficiency of Projections;**

(ii) **Test for the Unbiasedness of Projections.**

Both tests have been practically used by Barrionuevo (1993), Artis (1997), Gavin & Mandal (2003), as well as Takagi & Kucur (2006). They have also analyzed the optimism bias on the IMF projections being focused, however, on some older datasets.

Before proceeding to IMF Projections efficiency and unbiasedness testing, we estimate the following pairs of models: pooled ordinary least squares versus least squares dummy variable model and fixed effects versus random effects model for panel data.

5.2.1. Pooled OLS versus LSDV Model

Pooled OLS model is the basic panel data model which analyzes the influence of the forecasted GDP growth rate and of the year-dummy variables on the actual GDP growth rate variable. The basic intuition guides us to believe that this equation does not omit any significant information given that the forecasted value of a variable should contain in it all relevant information for the actual variable value.

From the POLS regression output (Table AP1), we obtain a result which reveals a strongly significant value of the forecasted inflation coefficient ($\alpha_1 = 0.925$).

POLS model: $$g_{i,t,t+1} = 1.299 + 0.925 \times g_{i,t,t-1} + \varepsilon_i + v_{i,t} \quad \textbf{5.2.4}$$

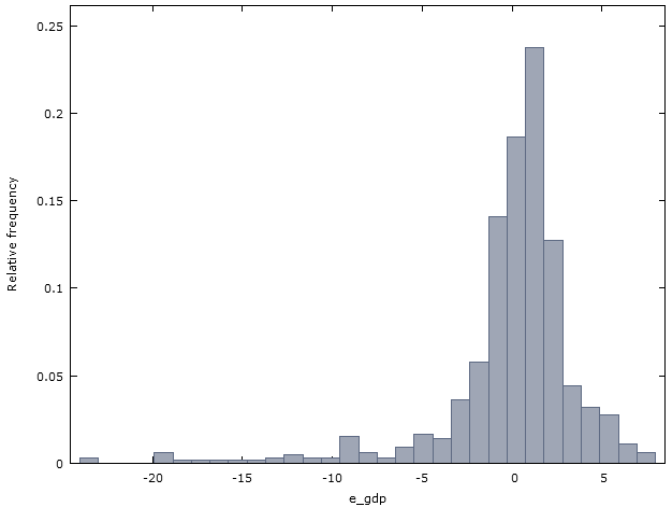
However, given the simplicity of the POLS assumptions we can suspect several errors affecting the results. In this respect, we consider the abnormality of errors distribution as a potential problem, and we test it using a heteroskedasticity test. In our regression the heteroskedasticity might appear due to GDP growth rate fluctuations: drops during crises and jumps during economic booms which are not captured by forecasts and which might serve as a significant factor to forecasts underperformance.

As can be seen from Figure 5.3, the distribution of the errors does not seem normal, given that the left tail of the distribution is larger than the right one.

For the heteroskedasticity test, we consider two hypotheses. Under the first one we ascertain that the model errors have a constant variance:

H_0: $Var(\varepsilon_{i,t}) = \sigma^2$ Homoskedasticity;
H_A: $Var(\varepsilon_{i,t}) \neq \sigma^2$ Heteroskedasticity.

Figure 5.3: Box-Plot of the GDP Growth Rate Model Errors



Source: Author's Computations, GRETL

In order to perform the test, we used the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity. Based on the test outcome (Table 5.2) we strongly reject the null hypothesis of homoskedasticity in favor of heteroskedasticity.

Table 5.2: GDP Growth Rate: Heteroskedasticity Test for POLS Model

```
hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of act_gdp

         chi2(1)      =    90.94
         Prob > chi2  =   0.0000
```

Source: Author's computation using STATA

The robust option is further used in our regression in order to control for the heteroskedasticity effects and to obtain the true standard errors for the coefficients. After a robust regression, the coefficients do not change, while the standard error of the forecasted inflation rate slightly increases (Table AP2).

Additionally, we test for multicollinearity which is the situation in which two or more explanatory variables are highly linearly related. Given that our regression includes 21 dummy variables we should consider the multicollinearity as a potential problem. The VIF test results (Table AP3), however, reject multicollinearity, given that test value is considerably smaller than 10 ($VIF_{POLS} = 1.90$), the comparison being based on the rule of thumb.

At the further stage we estimate the LSDV model which is also known as fixed effects least squares model. As compared to the POLS, LSDV considers not only time-dummies, but also individual-dummies (country). From the regression output (Table AP4) we note that forecasted inflation ($\alpha_1 = 0.463$) which is significant under a 90% confidence level, is considerably smaller than the same coefficient provided by the POLS regression.

LSDV model: $$g_{i,t,t+1} = 3.95 + 0.463 \times g_{i,t,t-1} + \varepsilon_{i,t} \quad \textbf{5.2.5}$$

Furthermore, as compared to the POLS model, the LSDV one includes more dummy variables (+29), suggesting that a loss of degrees of freedom caused by such a large number of independent variables can potentially caused some multicollinearity problems. Using the VIF test we find (Table AP5) that even though the value of the test is slightly higher than the one for POLS test ($VIF_{LSDV} = 2.11$), these linear dependencies among explanatory variables are negligible.

As already explained, the difference between POLS and LSDV models consists in the presence of country-dummy variables in the latter model. Respectively, in order to test which of the two models has a greater explanatory power over the relationship between actual and forecasted GDP growth rate we consider testing for the joint-significance of country-dummy variables. The hypotheses to be tested on the LSDV model are:

H_0: $d_{country2} = d_{country3} = [\dots] = d_{country29} = d_{country30} = 0$

H_A: at least one country-dummy variable is significant.

According to the F-test results (Table AP4) we reject the null hypothesis under a 90% significance level and we find the country-dummy variables significant. Therefore, we conclude that LSDV model is preferred over the pooled OLS model.

Finally, in order to ensure that the within variability in the LSDV model is fully captured, while the standard errors are robust, we use the cluster feature (Table AP6) which ensures that the model regression takes into account variables grouped per country. The cluster option could not be included into the model before the F-test given that the number of clusters should be significantly larger than the number of restrictions which doesn't hold for our dataset where 29 restrictions have been applied.

5.2.2. FE versus RE Model: Hausman Specification Test

The main distinction between the FE and RE models concerns in the assumption that under the RE model there is no correlation between the explanatory variable and the error term. The FE model does not assume correlation being equal to zero (the country-specific error is considered to be a non-random parameter, dummy variable). However, the large number of variables in the FE model causes a considerable loss of degrees of freedom which can be avoided by assuming errors random (Baltagi 2005).

In order to find the best model to be used, the Hausman Specification Test (Hausman 1978) is considered. This test compares the fixed effects and random effects models' parameters, concluding on the correlation between regressors and model error:

H_0: $E\left[g_{i,t,t-1}^{T}\varepsilon_{i,t}\right] = 0$ - Random Effects model preferred;

H_A: $E\left[g_{i,t,t-1}^{T}\varepsilon_{i,t}\right] \neq 0$ - Fixed Effects model preferred.

The test is based on two estimates (the coefficients from the random and, respectively, fixed effects models for the forecasted GDP growth rate variable). The RE model coefficient ($\hat{\alpha}_{1_{RE}}$) is consistent and efficient under H_0 and becomes inconsistent under H_A; while the FE model coefficient ($\hat{\alpha}_{1_{FE}}$) is consistent and inefficient under H_0 and inconsistent under H_A. The test resides primarily on the estimation of W (5.2.6).

$$W = \left(\hat{\alpha}_{1_{RE}} - \hat{\alpha}_{1_{FE}}\right)^{T} \times \left[var\left(\hat{\alpha}_{1_{RE}}\right) - var\left(\hat{\alpha}_{1_{FE}}\right)\right]^{-1} \times \left(\hat{\alpha}_{1_{RE}} - \hat{\alpha}_{1_{FE}}\right) \sim X_{kw}^{2} \qquad \textbf{5.2.6}$$

If W is significant, given an asymptotic distribution with kw standing for the number of regressors in the within regression, we reject H_0, and FE model is preferred.

Before proceeding to the Hausman Specification Test estimation, the random effects model is regressed and the estimates are stored (Table AP7). The same is done for the fixed effects model (Table AP8). The models outputs for these regressions are summarized in the (5.2.7) and (5.2.8) equations. The FE model, additionally, requires a test for the presence of the fixed effects, which assumes testing for the joint-significance of the year dummy-variables. The test for the fixed effects, thus, has the hypotheses:

H_0: $d_{2000:2} = d_{2001:1} = d_{2001:2} = [\dots] d_{2010:1} = d_{2010:2} = 0$

H_A: at least one year-dummy variable is $\neq 0$.

From the test output in Table AP9, we conclude that the year-dummy variables in the FE model are strongly jointly-significant. Further we proceed to comparison of the RE and FE models using the Hausman Specification Test.

FE Model: $$g_{i,t,t+1} = 2.81 + 0.463 \times g_{i,t,t-1} + \varepsilon_i + v_{i,t} \quad \textbf{5.2.7}$$

RE Model: $$g_{i,t,t+1} = 1.94 + 0.729 \times g_{i,t,t-1} + \varepsilon_i + v_{i,t} \quad \textbf{5.2.8}$$

The saved estimates of the RE and FE models are further tested for the relationship between the independent variable (forecasted GDP growth rate) and the error term. Hausman Test results are presented in Table AP10.

From the test results we conclude that we cannot reject the null hypothesis. Respectively we find a close to zero correlation between the model's error and the explanatory variable ($E\left[g_{i,t,t-1}^{T}\varepsilon_{i,t}\right] = 0$). Accordingly, in the further estimations we give preference to RE model over the FE model.

5.2.3. GDP Growth Rate Model: Empirical Models Comparison

So far we have regressed four different models representing the relationship between the actual and forecasted GDP growth rate. The models results are summarized in Table 5.3.

Table 5.3: GDP Growth Rate Models Comparison: POLS, LSDV, FE and RE

	Pooled OLS	**LSDV**	**FE**	**RE**
const.	1.2993 *** (0.010)	3.9510 ** (0.012)	2.8091 *** (0.000)	1.9399 *** (0.001)
GDP forecast	0.9247 *** (0.000)	0.4629 * (0.067)	0.4629 *** (0.000)	0.7288 *** (0.000)

Source: Author's computation using STATA

The zero-restriction imposed on the country-dummy variables showed that LSDV model is preferred over the POLS model, while Hausman Specification Test did not reject the hypothesis of a zero correlation between the independent variable and the error term, concluding on the preference of RE model over the FE model. Respectively, for the further tests of efficiency and unbiasedness of IMF projections concerning the GDP growth rate, the LSDV and RE models are considered.

5.2.4. Test for Efficiency of GDP Growth Rate IMF Projections

The efficiency of projections refers to the test of the volume of information contained in the forecast. A perfectly efficient projection has no error, a zero-intercept and a coefficient of the independent variable equal to one. The test for the efficiency of projections, introduced by Barrionuevo (1993), compares the following hypotheses:

H_0:	$\alpha_0 = 0 \ \& \ \alpha_1 = 1$	Projections are Efficient;
H_A:	$\alpha_0 \neq 0 \ \& \ \alpha_1 \neq 1$	Projections are Inefficient.

The joint-hypothesis is tested using linear restrictions and F-test which are applied on both models: LSDV and RE. According to test results (Table AP11 and Table AP12) we strongly reject the null-hypothesis for both models and conclude that the projections provided by IMF are inefficient.

These results are consistent with the evidences from Tagaci and Kucur (2006) who have also determined that the inefficiency of IMF projections is especially distinguishable for the industrial countries, Middle East, and Emerging Asia. The inefficiency of IMF forecasts informs us on the presence of an either upwards or downwards bias.

5.2.5. Test for Unbiasedness of GDP Growth Rate IMF Projections

The analysis of the GDP growth rate forecasts errors and model errors will help building a stronger image on the existence or inexistence of the optimism bias. In this respect it is important to mention that model error and forecast error are two different concepts, the first standing for the difference between actual and fitted value of the explained variable, while the former standing for the difference between actual and forecasted value.

Model Error: $$\varepsilon_{i,t} = g_{i,t,t+1} - \hat{g}_{i,t,t+1} \quad \textbf{5.2.9}$$

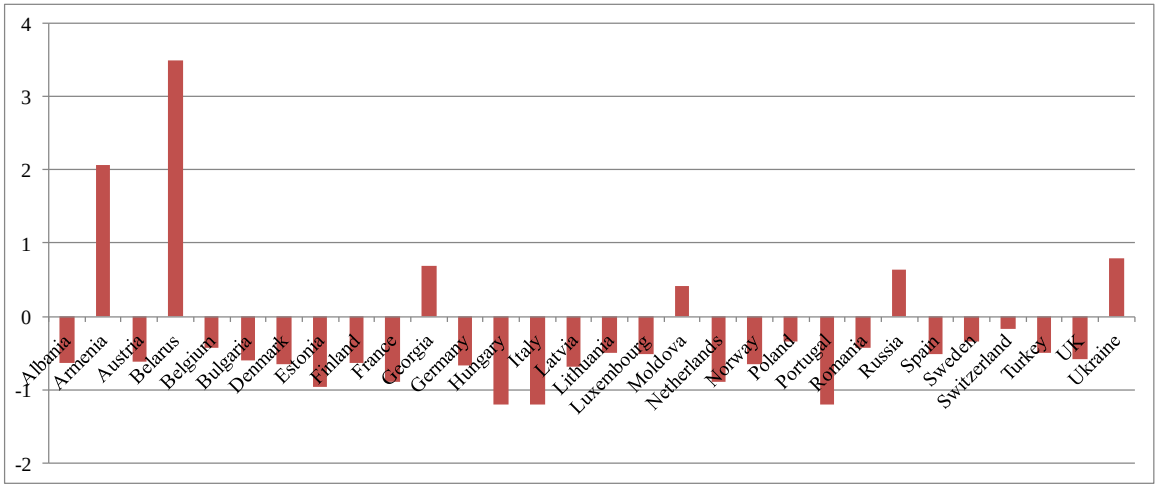
Fitted Value: $$\hat{g}_{i,t,t+1} = \alpha_0 + \alpha_1 \times g_{i,t,t-1} \quad \textbf{5.2.10}$$

Forecast Error: $$e_{i,t} = g_{i,t,t+1} - g_{i,t,t-1} \quad \textbf{5.2.11}$$

The average forecast error per country for the observed period is represented in Figure 5.4. Interestingly to notice, there can be seen only 6 countries (all of them being developing countries: Armenia, Belarus, Georgia, Moldova, Russia, and Ukraine) out of

30 for which IMF on average underestimated the forecasts, while for all 24 others the forecasts were on average overpredicted (Table AP13).

Figure 5.4: GDP Growth Rate Forecast Errors per Country



Source: Author's computations, IMF Data

The unbiasedness test, suggested by Tagaci and Kucur (2006), is used to determine the relationship between the forecast error and model error (5.2.12).

$$e_{i,t} = \beta_0 + \beta_1 \times \varepsilon_{i,t} \qquad \textbf{5.2.12}$$

Respectively, the two hypotheses of the unbiasedness test are as follows:

H_o: $\beta_0 = 0$ - IMF predictions are unbiased;

H_A: $\beta_0 \neq 0$ - IMF predictions are biased.

In order to test the null hypothesis we apply a null-intercept restriction on the (5.2.12) equation for both considered models, LSDV and RE. Afterwards we use an F-test to base the conclusion on. The output for the models is represented in Table AP14 (LSDV) and Table AP15 (RE). According to the outputs of the F-tests, we reject the IMF unbiasedness hypothesis under a 95% confidence level interval. This conclusion is sustainable for both models.

Moreover, the unbiasedness test shows that on average IMF overpredicts the GDP growth rate for the observed countries by 0.258% (absolute value). This empirically confirms the presence of the optimism bias in the analyzed data sample.

5.2.6. GDP Growth Rate and Optimism Bias: Results Interpretation

In order to attest the optimism bias presence in the GDP growth rate forecasts which are released by the IMF, we have analyzed several models in which the dependent variable was represented by the actual one-year-after value of the GDP growth rate, while the independent variable was the forecasted one-year-before value of the same variable.

The models that we have analyzed were: pooled OLS, LSDV, RE model and FE model. The F-test, analyzing the significance of the country-dummy variables, showed that LSDV model (5.2.5) is preferred over the pooled OLS model. We found the country-dummy variables being significant in explaining the accuracy of forecast. On the other hand, Hausman Specification Test gave preference to RE model (5.2.8) over the FE model based on the finding of an insignificant correlation between forecasted GDP growth rate and the residual of the model.

The efficiency of projections test rejected the efficient predictions hypothesis. The respective conclusion was consistent with the results in both considered models (LSDV and RE model) which supported projections inefficiency under a 99% confidence level.

The unbiasedness test specifically pointed that IMF projections for the GDP growth rate are biased upwards (under a 95% confidence level), such that on average GDP growth rate forecasts provided by the respective institution, for the 30 countries which were observed in the analysis, is overestimated by 0.258%, in absolute values.

Respectively, the performed analysis found a considerable upward bias of the GDP growth rate forecasts. We found that the optimism bias is present in the evaluated dataset.

5.3. Testing Optimism Bias on Inflation rate Forecasts

According to Bulíř et al. (2007) inflation forecast is one of the most important communication tools used by the central monetary institutions, being one of the determinants of the actual inflation by having a direct impact on the price level expectation. The overprediction of the inflation rate can be an important factor for per se having a high inflation, thus the underprediction is a rational tool for maintaining prices at a lower level. From this perspective we further test the hypothesis of optimism bias in IMF projections for the inflation rate which supposes its underprediction.

The so far performed researches on the accuracy of IMF predictions of the inflation rate in several lines accepted and rejected the hypothesis of optimism in forecasts. Timmermann (2006) conducted an analysis of the optimism bias in the IMF inflation rate predictions for 178 countries, for the period 1990-2003 and concluded that on average there is a downward bias in forecasts, while the underestimation is especially significant for many African, Central and Eastern European, and Western Hemisphere countries.

Dreher et al. (2007) investigated the IMF inflation forecasts for 157 countries (1999-2005) and found that countries with large loans outstanding from the IMF received lower inflation forecasts, suggesting that the IMF engages in "defensive forecasting." A complex view on the accuracy of IMF projections is given by Tuguci & Kucur (2006) who have analyzed 105 countries (1994-2003). They concluded that the inflation rate forecasts for emerging Asia and transition economies did not have a consistent bias; the forecasts for Latin America were pessimistic, while those for Middle East - optimistic.

We are going to test the optimism bias presence in the IMF forecasts for inflation rate across 30 countries. The dataset has similar time and individual dimensions as the GDP growth rate dataset had. There are 22 periods for examination and two main variables to be evaluated are the one-year-before forecast and one-year-after actual inflation rate.

Table 5.4: Inflation Rate Descriptive Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations	
fc_infl	overall	5.170952	12.75538	-3.527	250	N =	660
	between		6.85072	1	35.43768	n =	30
	within		10.8288	-24.24373	219.7333	T =	22
act_infl	overall	6.054215	12.07192	-1.224	169	N =	660
	between		7.339349	.9391818	34.60459	n =	30
	within		9.673759	-21.55038	140.4496	T =	22

Source: Author's Computation, STATA

The summary of the initial data (Table 5.4) presents that the available dataset covers 22 time-periods across 30 countries. The analysis of within and between variability shows that while the forecasted inflation has a smaller variability for the data between countries, the actual value of the inflation has a smaller variability for within country data.

The mean of the variables is higher for actual inflation rate values comparing to the forecasts suggesting that, at this stage, we can suspect average underprediction.

In order to test if the forecasts of the inflation rate are underestimated, the model (5.3.1) will be used. The relationship between forecasted inflation and actual inflation will be analyzed, similarly to the GDP growth rate case, from four perspectives: pooled OLS model, LSDV, RE and FE models. Out of these four models we will select two in order to test the efficiency and unbiasedness of IMF projections for the inflation rate.

$$r_{i,t,t+1} = \varphi_0 + \varphi_1 \times r_{i,t,t-1} + \omega_{i,t} \qquad \textbf{5.3.1}$$

In the general inflation model $r_{i,t,t+1}$ stands for one-year-after data, while $r_{i,t,t-1}$ reflects one-year-before forecast for inflation rate. The constant term is represented by φ_0, the coefficient is φ_1, while the model error term ($\omega_{i,t}$) can be decomposed into a country-specific error component (ω_i), and a residual reminder component ($u_{i,t}$).

$$\omega_{i,t} = \omega_i + u_{i,t} \qquad \textbf{5.3.2}$$

In order to test the optimism bias in our data we will first compare the POLS, LSDV, RE and FE models. The F-test for the significance of the country-dummy variables will provide info for selecting either POLS or LSDV model as being more comprehensive in explaining the relationship between our variables, while Hausman Test will compare FE and RE models results. On the chosen models two sets of tests will be performed: test for efficiency of projections and test for their unbiasedness.

5.3.1. Pooled OLS versus LSDV Model

The pooled OLS, considered in this respect as a benchmark to more sophisticated models, gives a simplistic overview on the relationship between inflation forecast and actual data. Regardless of being easy to run, the POLS model can be subject to several types of errors, thus after modeling the initial regression (Table AP16), we can suspect that the errors of the model are not normally distributed. This intuition arises from the inflation uncertainty which can vary from crisis periods to booms.

POLS model: $$r_{i,t,t+1} = 8.188 + 0.719 \times r_{i,t,t-1} + \omega_{i,t} \qquad \textbf{5.3.3}$$

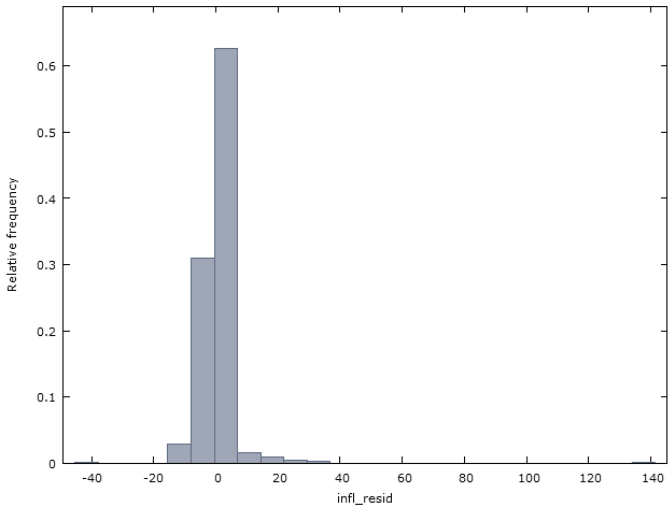
Figure 5.5 gives an intuition for non-normal distribution of the residuals given a fatter right-hand side tale where most of the model errors are placed.

The Breusch-Pagan/ Cook-Weisberg heteroskedasticity test is used to test if the variance of the residuals in the model is constant or not. The hypotheses of this test are:

H_0: $Var(\omega_{i,t}) = \sigma^2$ Homoskedasticity;

H_A: $Var(\omega_{i,t}) \neq \sigma^2$ Heteroskedasticity.

Figure 5.5: Inflation Rate, POLS Model Errors Distribution



Source: Author's computations in GRETL

According to the test results (Table 5.5), we strongly reject the null hypothesis and conclude that the variance of the errors in the POLS model is not constant.

Table 5.5: Inflation Rate, Heteroskedasticity Test for POLS Model

```
hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of act_infl

         chi2(1)      =  2049.41
         Prob > chi2  =   0.0000
```

Source: Author's computation using STATA

In order to control for heteroskedasticity in the POLS model we use the *robust* command. The regression output (Table AP17) shows that the estimators of the model did not change, however the standard errors increased for the forecasted inflation rate estimator, while the standard deviations for all the others estimators decreased.

Additionally, the VIF test (Table AP18) shows that there is no multicollinearity problem in the data, test value being at a tolerable level ($VIF_{POLS} = 1.87$).

Further we proceed with the estimation of the LSDV model which is a replication of the POLS with the exception of 29 country-dummy variables (out of 30) which are added into the model (Table AP19).

LSDV model: $$r_{i,t,t+1} = 7.753 + 0.582 \times r_{i,t,t-1} + \omega_{i,t}$$ **5.3.4**

The significance of the individual (country) dummies is to be further tested using an F-test with a joint zero-restriction, such that according to this test results we can conclude if the country-dummy variable is important in characterizing the IMF projections accuracy for the inflation rate. The F-test hypotheses are as follows:

H_0: $d_{country2} = d_{country3} = [\dots] = d_{country29} = d_{country30} = 0$

H_A: at least one country-dummy variable is significant.

After regression of the initial model and testing for the significance of country-dummy variables (Table AP19), we conclude that we can strongly reject the null hypothesis. Respectively, we give preference to the LSDV model as compared to the POLS model based on the joint significance of the country-dummy variables.

Additionally in order to remove any heteroskedasticity from the LSDV model, as well as for removing any serial correlation, we use the cluster option for countries (Table AP20). The VIF test (Table AP21) finds no multicollinearity problems ($VIF_{POLS} = 1.92$).

5.3.2. FE and RE Model: Hausman Specification Test

The other two models to be derived and compared are fixed effects and random effects model. While random effects model (Table AP22) assumes that there is no correlation between inflation forecast and the error term (which is assumed to be random), the fixed effects model (Table AP23) regards the country specific time invariant effect as independent variable which has a non-zero correlation with the explanatory variable.

RE model: $$r_{i,t,t+1} = 8.818 + 0.719 \times r_{i,t,t-1} + \omega_{i,t}$$ **5.3.5**

FE model: $$r_{i,t,t+1} = 9.855 + 0.582 \times r_{i,t,t-1} + \omega_{i,t}$$ **5.3.6**

Before proceeding to the Hausman Test we also check for the presence of the fixed effects in the FE model. We use an F-test and evaluate the joint significance of the year dummies. The test for fixed effects has the following hypotheses:

H_0: $d_{2000:2} = d_{2001:1} = d_{2001:2} = [\dots] d_{2010:1} = d_{2010:2} = 0$

H_A: at least one year-dummy variable is $\neq 0$.

According to the test results (Table AP24), we reject the null hypothesis under a 99% confidence level interval and find the fixed effects present in the FE model.

Hausman Specification Test is further used to compare the RE and FE models.

H_0: $E\left[r_{i,t,t-1}^{T}\omega_i\right] = 0$ - Random Effects model preferred;

H_A: $E\left[r_{i.t,t-1}^{T}\omega_i\right] \neq 0$ - Fixed Effects model preferred.

According to the performed test (Table AP25), we strongly reject the null hypothesis, and conclude that the fixed effects model is preferred over the RE model. Consequently, we find that the inflation rate model hides a non-zero correlation between the country specific effects and the explanatory variables.

Moreover, unlike the RE model, FE model requires a test for heteroskedasticity. In order to test if the FE model errors have a constant variance we use the Modified Wald Test, according to which we strongly reject the homoskedasticity hypothesis and conclude that the further estimation of FE model requires control for heteroskedasticity, which is done using the robust option (Table AP26).

Table 5.6: Inflation Rate, Heteroskedasticity Test for FE Model

```
xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (30)  =   18120.28
Prob>chi2 =      0.0000
```

Source: Source: Author's computation using STATA

5.3.3. Inflation Rate: Empirical Models Comparison

The relationship between actual and forecasted inflation rate has been modeled from four different perspectives. The models outputs are summarized in Table 5.7.

Due to a joint-significance of country-dummy variables, we gave preference to LSDV model over the POLS model. The Hausman Test indicated a non-zero correlation between the country specific effects and the forecasts of the inflation rate, according to which FE model is chosen over RE model. Consequently, the further efficiency and unbiasedness analysis of IMF projections will be performed on LSDV and FE models.

Table 5.7: Inflation Rate Models Comparison: POLS, LSDV, FE and RE

	Pooled OLS	**LSDV**	**FE**	**RE**
const.	8.8183 ** (0.070)	7.7530 * (0.134)	9.8548 *** (0.000)	8.8183 *** (0.000)
GDP forecast	0.7190 *** (0.000)	0.5820 *** (0.000)	0.5819 *** (0.000)	0.7190 *** (0.000)

Source: Author's computation using STATA

5.3.4. Test for Efficiency of Inflation Rate IMF Projections

The test for efficiency of the IMF projections for the inflation rate will be further performed using the Barrionuevo (1993) method. Accordingly, an efficient projection of inflation rate would be characterized by a zero mean of forecast error and a coefficient of the explanatory variable (forecasted inflation rate) of one.

H_0: $\varphi_0 = 0 \ \& \ \varphi_1 = 1$ Projections are Efficient;

H_A: $\varphi_0 \neq 0 \ \& \ \varphi_1 \neq 1$ Projections are Inefficient.

In order to test the joint-hypothesis of coefficients, a linear restriction is applied and an F-test is used to compare the restricted and unrestricted models. According to the test, which is applied on both LSDV model, as well we FE model (Table AP27 and Table AP28) we reject the null hypothesis under a 99% confidence level and conclude that the IMF projections for inflation rate, for the observed data sample, are inefficient.

The inefficiency of IMF projections suggests that the mean of forecast errors is non-zero, but biased either upwards or downwards. The unbiasedness test is further used to determine the forecast error, as well as the direction of the bias.

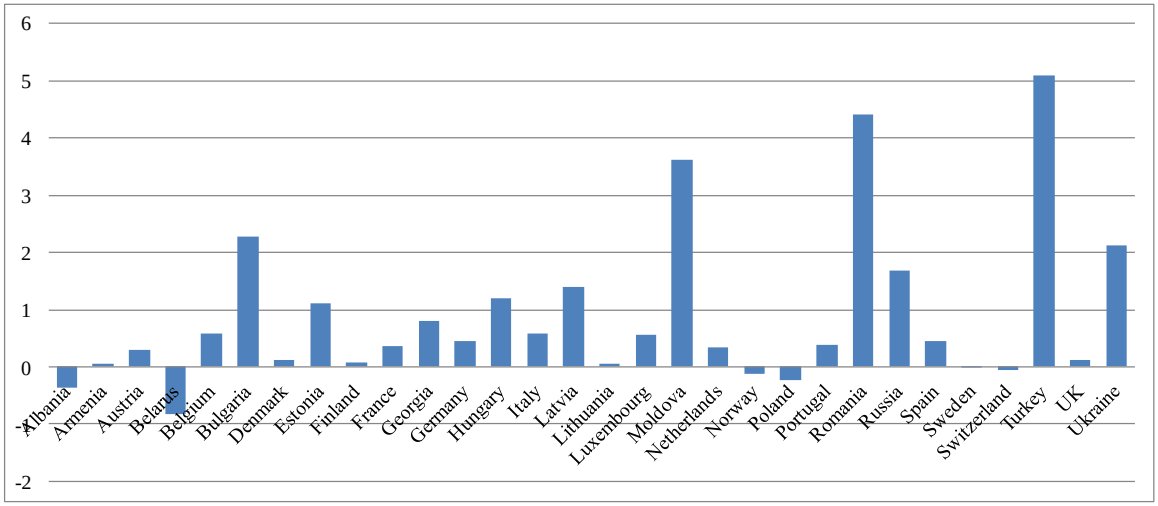
5.3.5. Test for Unbiasedness of Inflation Rate IMF Projections

The test for unbiasedness resides primarily on the analysis of two variables: forecasts error and model error. While the model errors are slightly different for the LSDV model and FE model, the forecast error have no linkage to any specific model being a difference between the actual inflation rate and its forecast.

As can be seen from Figure 5.6, out of 30 analyzed countries, only for 6 of them IMF on average overpredicted the inflation rate (Albania, Belarus, Poland, Norway, Switzerland

and Sweden), the other 24 countries were provided with underestimated projections (Table AP29 for detailed data).

Figure 5.6: Inflation Rate Forecasts Errors per Country



Source: Author's computations in Excel

The unbiasedness test is further used to find the value of the average forecast deviation. The test resides on the (5.3.7) model and analyses the relation between inflation forecast error as dependent variable and model error as independent variable (Tagaci & Kucur, 2006).

$$\mu_{i,t} = \theta_0 + \theta_1 \times \omega_{i,t} \qquad \textbf{5.3.7}$$

After running the respective regression, a zero restriction for the constant term is imposed ($\theta_0 = 0$). Respectively, the two hypotheses of the unbiasedness test are as follows:

H_0: $\theta_0 = 0$ - IMF predictions are unbiased;

H_A: $\theta_0 \neq 0$ - IMF predictions are biased.

The F-test rejects the null hypothesis under a 99% confidence level for both LSDV model (Table AP30) and FE model (Table AP31). We conclude that IMF projections for the inflation rate are neither efficient, nor unbiased.

Moreover, according to both models (LSDV with country-clusters and robust FE) the deviation of the IMF forecasts for the inflation rate is on average by 0.8832% (absolute value). The positive sign of the inflation forecast error reveals that the actual inflation rate is higher than the forecasted one, such that we conclude on the presence of optimism bias in the analyzed dataset.

5.3.6. Inflation Rate and Optimism Bias: Results Interpretation

The optimism bias presence in the inflation rate forecasts provided by the IMF was tested by comparing the one-year-before forecasts and one-year-after actual inflation rate for a dataset comprising 30 countries for 22 periods.

In order to assess the presence of a downward bias, four models were considered: pooled OLS, LSDV, RE model and FE model. After assessing a joint-significance of the country-dummy variables, the LSDV model (5.3.4) was preferred over the pooled OLS model. Similarly, the comparison between the random effects model and fixed effects model (5.3.6) was grounded on the Hausman Specification Test results that attested a non-zero correlation between the explanatory variable of the model and the individual specific error term.

The test for efficiency showed that according to the estimates of the LSDV model, as well as the FE model, the IMF projections are inefficient. The inefficiency of inflation rate forecasts suggests a significant forecast error which, according to the test for unbiasedness encounters for a downward bias in IMF projection of 0.8832% in absolute value. Following these results, we find the empirical evidence of optimism bias presence in the IMF projections for the inflation rate.

VI. CONCLUSION

Despite a wide range of empirical methods available to the economists to forecast the future, none of them provides consistently efficient and unbiased forecasts.

In order to assess the biases which affect the accuracy of economic forecasts, we went through an analysis of the history of economic forecasting from the perspective of ancient Egypt, Old Testament and ancient Greece. We found that the major difference between ancient and current forecasting tools consists in the approach type: ancients mostly relied on non-scientific forecasting methods (dreams, magic, religion, premonition, etc.), while nowadays economists accounts only for scientific approaches.

Even though there are several aspects which modern economics have learnt from ancients (e.g. cyclicality), most of their forecasting methods are either forgotten, or ignored. Ancient Greece can be regarded as one of the most influential building blocks for nowadays forecasting tools. Their contribution is mainly felt in quantification and requirements for proof.

We have also analyzed the relationship between the accuracy of IMF forecasts and the level of countries development. We considered GDP growth rate and inflation rate one-year-before forecast and one–year-after actual value, for the period between 2000 and 2010, and a set of 15 developed and 15 developing countries. The analysis was based on six forecasting evaluation measures: MSE, RMSE, MAD, MAPE, LAD and MeAE. According to estimation results, we found that developed countries are provided with a set of more accurate data as compared to developing countries.

In this sense, we have also introduced the concept of *misleading data trap*. Accordingly, we assume that it is not only the volatility of a poor economy the cause of weakly captured economic data (i.e. inaccurate economic forecasts), but the inaccurate economic forecasts are a cause of economic volatility as such, given that the vast majority of socio-economic policies are based on erroneous economic forecasts. The test of this cross-correlation can serve as a subject for further analyses.

Additionally, among several biases which directly or indirectly affect the accuracy of economic predictions, we have empirically tested the implication of optimistic bias on the GDP growth rate forecasts and inflation rate forecasts provided by IMF. We have based our analysis on four econometric models for panel data, out of which LSDV with country-clusters and RE models proved to be the most reliable for the GDP growth rate data, while LSDV with country-clusters and robust FE proved to explain the best the data for inflation rate.

Based on the respective models we have tested the efficiency and unbiasedness of the IMF forecasts and found that neither for GDP growth rate, nor for inflation rate, IMF provides efficient and unbiased forecasts. We have specifically determined that GDP growth rate forecasts are biased upwards with, on average, 0.258% in absolute value for the given dataset. The inflation rate proved to be biased downwards, such that on average the underestimation of the actual data is of 0.8832% in absolute value.

Consequently, these biases support the hypothesis of optimism bias presence in the IMF forecasts.

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APPENDIX

Table AP1: GDP Growth Rate, POLS Model

```
reg act_gdp fc_gdp d_20002-d_20102

      Source |       SS       df       MS              Number of obs =     660
-------------+------------------------------           F( 22,   637) =   41.81
       Model |  7489.80114    22  340.445506            Prob > F      =  0.0000
    Residual |   5186.9201   637  8.14273171            R-squared     =  0.5908
-------------+------------------------------           Adj R-squared =  0.5767
       Total |  12676.7212   659  19.2362993            Root MSE      =  2.8535

------------------------------------------------------------------------------
     act_gdp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      fc_gdp |   .9247622   .0641996    14.40   0.000     .7986938    1.050831
     d_20002 |   .3172975   .7368201     0.43   0.667    -1.129593    1.764188
     d_20011 |  -1.785647   .7375869    -2.42   0.016    -3.234043   -.3372517
     d_20012 |  -1.951425   .7384378    -2.64   0.008    -3.401492   -.5013587
     d_20021 |  -1.669592   .7377712    -2.26   0.024     -3.11835   -.2208343
     d_20022 |  -1.227581   .7369627    -1.67   0.096    -2.674751    .2195886
     d_20031 |  -1.278918   .7377568    -1.73   0.083    -2.727647    .1698115
     d_20032 |  -.8375496   .7372015    -1.14   0.256    -2.285189    .6100893
     d_20041 |   .3815203   .7370879     0.52   0.605    -1.065896    1.828936
     d_20042 |   .5293361   .7369674     0.72   0.473    -.9178432    1.976515
     d_20051 |  -.2786259   .7372689    -0.38   0.706    -1.726397    1.169145
     d_20052 |  -.4221465   .7380762    -0.57   0.568    -1.871503     1.02721
     d_20061 |   .6142376    .737609     0.83   0.405    -.8342016    2.062677
     d_20062 |   .7479677   .7373752     1.01   0.311    -.7000123    2.195948
     d_20071 |   .3906916   .7376604     0.53   0.597    -1.057849    1.839232
     d_20072 |   .2197011   .7380385     0.30   0.766    -1.229581    1.668984
     d_20081 |  -2.834289   .7384839    -3.84   0.000    -4.284447   -1.384132
     d_20082 |  -3.038737   .7395763    -4.11   0.000    -4.491039   -1.586435
     d_20091 |  -10.15232   .7368134   -13.78   0.000     -11.5992   -8.705446
     d_20092 |  -9.067348   .7398534   -12.26   0.000    -10.52019   -7.614501
     d_20101 |    1.47501   .7662859     1.92   0.055     -.029742    2.979762
     d_20102 |   1.139886   .7597173     1.50   0.134    -.3519669    2.631739
       _cons |   1.299336   .5616824     2.31   0.021     .1963631    2.402309
------------------------------------------------------------------------------
```

Source: Author's computations in STATA

Table AP2: GDP Growth Rate, POLS Model with Robust Errors

```
reg act_gdp fc_gdp d_20002-d_20102, robust

Linear regression                                      Number of obs =     660
                                                       F( 22,   637) =   24.10
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.5908
                                                       Root MSE      =  2.8535

------------------------------------------------------------------------------
             |               Robust
     act_gdp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      fc_gdp |   .9247622    .088095    10.50   0.000     .7517705    1.097754
     d_20002 |   .3172975   .5495968     0.58   0.564     -.761943    1.396538
     d_20011 |  -1.785647   .6389006    -2.79   0.005    -3.040253   -.5310415
     d_20012 |  -1.951425   .6860705    -2.84   0.005    -3.298659    -.604192
     d_20021 |  -1.669592   .5466413    -3.05   0.002    -2.743029   -.5961551
     d_20022 |  -1.227581   .5407523    -2.27   0.024    -2.289454   -.1657088
     d_20031 |  -1.278918   .6544685    -1.95   0.051    -2.564094    .0062586
     d_20032 |  -.8375496   .6494549    -1.29   0.198    -2.112881    .4377818
     d_20041 |   .3815203   .5727648     0.67   0.506    -.7432152    1.506256
     d_20042 |   .5293361   .5467633     0.97   0.333    -.5443402    1.603012
     d_20051 |  -.2786259    .591005    -0.47   0.637     -1.43918    .8819278
     d_20052 |  -.4221465   .5833488    -0.72   0.470    -1.567666    .7233727
     d_20061 |   .6142376   .5467959     1.12   0.262    -.4595028    1.687978
     d_20062 |   .7479677   .5434147     1.38   0.169     -.319133    1.815068
     d_20071 |   .3906916   .5613458     0.70   0.487    -.7116204    1.493003
     d_20072 |   .2197011   .5447962     0.40   0.687    -.8501125    1.289515
     d_20081 |  -2.834289   .7221616    -3.92   0.000    -4.252395   -1.416184
     d_20082 |  -3.038737   .6586008    -4.61   0.000    -4.332028   -1.745446
     d_20091 |  -10.15232   1.116275    -9.09   0.000    -12.34435   -7.960299
     d_20092 |  -9.067348   1.051036    -8.63   0.000    -11.13126   -7.003433
     d_20101 |    1.47501   .6180553     2.39   0.017     .2613377    2.688682
     d_20102 |   1.139886   .6132592     1.86   0.064     -.064368     2.34414
       _cons |   1.299336   .5057917     2.57   0.010     .3061154    2.292557
------------------------------------------------------------------------------
```

Source: Author's computations in STATA

Table AP3: GDP Growth Rate, VIF Test for POLS model

```
vif

Variable |       VIF       1/VIF
-------------+----------------------
d_20101 |      2.07    0.484251
d_20102 |      2.03    0.492661
d_20092 |      1.93    0.519471
d_20082 |      1.92    0.519860
d_20081 |      1.92    0.521399
d_20012 |      1.92    0.521464
d_20052 |      1.92    0.521975
d_20072 |      1.92    0.522029
d_20021 |      1.91    0.522407
d_20031 |      1.91    0.522427
d_20071 |      1.91    0.522564
d_20061 |      1.91    0.522637
d_20011 |      1.91    0.522668
d_20062 |      1.91    0.522968
d_20051 |      1.91    0.523119
d_20032 |      1.91    0.523215
d_20041 |      1.91    0.523376
d_20042 |      1.91    0.523547
d_20022 |      1.91    0.523554
d_20002 |      1.91    0.523756
d_20091 |      1.91    0.523766
fc_gdp |      1.39    0.720218
-------------+----------------------
Mean VIF |      1.90
```

Source: Author's computations in STATA

Table AP4: GDP Growth Rate, LSDV Model with Year & Country-Dummies

```
reg act_gdp fc_gdp d_20002-d_20102 d_country2-d_country30

      Source |       SS       df       MS              Number of obs =     660
-------------+------------------------------           F( 51,   608) =   22.97
       Model |  8344.85108    51  163.624531            Prob > F      =  0.0000
    Residual |  4331.87016   608  7.12478646            R-squared     =  0.6583
-------------+------------------------------           Adj R-squared =  0.6296
       Total |  12676.7212   659  19.2362993            Root MSE      =  2.6692

------------------------------------------------------------------------------
     act_gdp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      fc_gdp |   .4629928   .0925396     5.00   0.000     .2812569    .6447288
     d_20002 |   .2638861   .6892752     0.38   0.702    -1.089763    1.617535
     d_20011 |  -1.537985   .6909769    -2.23   0.026    -2.894976   -.180994
     d_20012 |  -1.596017   .6928627    -2.30   0.022    -2.956711   -.2353222
     d_20021 |  -1.394993   .6913856    -2.02   0.044    -2.752787   -.0371993
     d_20022 |  -1.110446   .6895918    -1.61   0.108    -2.464717    .243825
     d_20031 |   -1.00632   .6913538    -1.46   0.146    -2.364051    .3514113
     d_20032 |  -.6588449    .690122    -0.95   0.340    -2.014157    .6964672
     d_20041 |    .534058   .6898697     0.77   0.439    -.8207587    1.888875
     d_20042 |   .6480108   .6896023     0.94   0.348    -.7062808    2.002303
     d_20051 |  -.0860681   .6902716    -0.12   0.901    -1.441674    1.269538
     d_20052 |  -.1079895   .6920617    -0.16   0.876    -1.467111    1.251132
     d_20061 |   .8652862    .691026     1.25   0.211    -.4918014    2.222374
     d_20062 |   .9605355   .6905074     1.39   0.165    -.3955335    2.316605
     d_20071 |   .6494363     .69114     0.94   0.348    -.7078752    2.006748
     d_20072 |   .5292405   .6919782     0.76   0.445     -.829717    1.888198
     d_20081 |  -2.473955   .6929649    -3.57   0.000    -3.834851    -1.11306
     d_20082 |  -2.576814   .6953812    -3.71   0.000    -3.942455   -1.211173
     d_20091 |  -10.10398   .6892602   -14.66   0.000     -11.4576   -8.750356
     d_20092 |  -9.551682   .6959933   -13.72   0.000    -10.91853    -8.18484
     d_20101 |  -.0396551   .7530761    -0.05   0.958    -1.518601    1.439291
     d_20102 |  -.1926416    .739119    -0.26   0.794    -1.644178    1.258894
  d_country2 |   2.498852   .8056674     3.10   0.002     .9166234    4.081081
  d_country3 |  -2.146118   .8876591    -2.42   0.016    -3.889368   -.4028682
  d_country4 |   2.733774   .8405755     3.25   0.001     1.082991    4.384558
  d_country5 |  -2.050865   .8938908    -2.29   0.022    -3.806354   -.2953768
  d_country6 |  -.8628961   .8195938    -1.05   0.293    -2.472475    .7466824
  d_country7 |  -2.356991   .9001786    -2.62   0.009    -4.124828   -.5891543
  d_country8 |  -1.061014    .814841    -1.30   0.193    -2.661258     .539231
  d_country9 |  -1.883563   .8684615    -2.17   0.030    -3.589111   -.1780146
 d_country10 |  -2.416698   .8873842    -2.72   0.007    -4.159409   -.6739881
 d_country11 |   .7304478    .811541     0.90   0.368    -.8633159    2.324211
 d_country12 |  -2.428313   .9047863    -2.68   0.007    -4.205199   -.6514277
 d_country13 |  -2.059325   .8449653    -2.44   0.015     -3.71873   -.3999203
 d_country14 |  -2.984928    .906037    -3.29   0.001     -4.76427   -1.205586
 d_country15 |  -.8345055   .8164052    -1.02   0.307    -2.437822    .7688109
 d_country16 |  -.7939792   .8207617    -0.97   0.334    -2.405851    .8178929
 d_country17 |  -1.240879   .8383732    -1.48   0.139    -2.887338    .4055801
 d_country18 |  -.0123265   .8253505    -0.01   0.988     -1.63321    1.608557
 d_country19 |   -2.44556   .8895241    -2.75   0.006    -4.192472   -.6986467
 d_country20 |  -2.108367   .8823631    -2.39   0.017    -3.841217   -.3755178
 d_country21 |  -.7960777   .8268641    -0.96   0.336    -2.419934    .8277787
 d_country22 |  -2.879435   .8984928    -3.20   0.001    -4.643961   -1.114909
 d_country23 |  -.8389362   .8251347    -1.02   0.310    -2.459396    .7815238
 d_country24 |   .2814541    .823246     0.34   0.733    -1.335297    1.898205
 d_country25 |  -1.821837   .8723152    -2.09   0.037    -3.534954   -.1087209
 d_country26 |  -1.757549   .8791998    -2.00   0.046    -3.484186    -.030912
 d_country27 |  -1.952212   .9065205    -2.15   0.032    -3.732504   -.1719207
 d_country28 |  -.7202148   .8183934    -0.88   0.379    -2.327436    .8870064
 d_country29 |   .0641692   .8390433     0.08   0.939    -1.583606    1.711944
 d_country30 |  -2.113117   .8880658    -2.38   0.018    -3.857166   -.3690682
       _cons |   3.951068   .9329829     4.23   0.000     2.118808    5.783328
------------------------------------------------------------------------------
```

```
. test d_country2 d_country3 d_country4 d_country5 d_country6 d_country7
d_country8 d_country9 d_country10 d_country11 d_country12 d_country13
d_country14 d_country15 d_country16 d_country17 d_country18 d_country19
d_country20 d_country21 d_country22 d_country23 d_country24 d_country25
d_country26 d_country27 d_country28 d_country29 d_country30

 ( 1)  d_country2 = 0
 ( 2)  d_country3 = 0
 ( 3)  d_country4 = 0
 ( 4)  d_country5 = 0
 ( 5)  d_country6 = 0
 ( 6)  d_country7 = 0
 ( 7)  d_country8 = 0
 ( 8)  d_country9 = 0
 ( 9)  d_country10 = 0
 (10)  d_country11 = 0
 (11)  d_country12 = 0
 (12)  d_country13 = 0
 (13)  d_country14 = 0
 (14)  d_country15 = 0
 (15)  d_country16 = 0
 (16)  d_country17 = 0
 (17)  d_country18 = 0
 (18)  d_country19 = 0
 (19)  d_country20 = 0
 (20)  d_country21 = 0
 (21)  d_country22 = 0
 (22)  d_country23 = 0
 (23)  d_country24 = 0
 (24)  d_country25 = 0
 (25)  d_country26 = 0
 (26)  d_country27 = 0
 (27)  d_country28 = 0
 (28)  d_country29 = 0
 (29)  d_country30 = 0

       F( 29,   608) =    4.14
            Prob > F =    0.0000
```

Source: Author's computations in STATA

Table AP5: GDP Growth Rate, VIF Test for LSDV model

```
vif

    Variable |       VIF       1/VIF
-------------+----------------------
      fc_gdp |      3.30    0.303302
 d_country27 |      2.45    0.407678
 d_country14 |      2.45    0.408113
 d_country12 |      2.44    0.409242
  d_country7 |      2.42    0.413442
 d_country22 |      2.41    0.414995
  d_country5 |      2.39    0.419279
 d_country19 |      2.36    0.423406
 d_country30 |      2.35    0.424798
  d_country3 |      2.35    0.425187
 d_country10 |      2.35    0.425451
 d_country20 |      2.32    0.430306
 d_country26 |      2.31    0.433408
     d_20101 |      2.28    0.438709
 d_country25 |      2.27    0.440277
  d_country9 |      2.25    0.444193
     d_20102 |      2.20    0.455434
 d_country13 |      2.13    0.469240
  d_country4 |      2.11    0.474154
 d_country29 |      2.10    0.475887
 d_country17 |      2.10    0.476648
 d_country21 |      2.04    0.490009
 d_country18 |      2.03    0.491808
 d_country23 |      2.03    0.492065
 d_country24 |      2.02    0.494326
 d_country16 |      2.01    0.497323
  d_country6 |      2.01    0.498741
 d_country28 |      2.00    0.500205
 d_country15 |      1.99    0.502645
  d_country8 |      1.98    0.504576
 d_country11 |      1.97    0.508688
     d_20092 |      1.95    0.513622
     d_20082 |      1.94    0.514527
  d_country2 |      1.94    0.516132
     d_20081 |      1.93    0.518121
     d_20012 |      1.93    0.518274
     d_20052 |      1.93    0.519475
     d_20072 |      1.92    0.519600
     d_20021 |      1.92    0.520491
     d_20031 |      1.92    0.520539
     d_20071 |      1.92    0.520861
     d_20061 |      1.92    0.521033
     d_20011 |      1.92    0.521107
     d_20062 |      1.92    0.521816
     d_20051 |      1.92    0.522172
     d_20032 |      1.91    0.522399
     d_20041 |      1.91    0.522781
     d_20042 |      1.91    0.523186
     d_20022 |      1.91    0.523203
     d_20002 |      1.91    0.523683
     d_20091 |      1.91    0.523706
-------------+----------------------
    Mean VIF |      2.11
```

Source: Author's computations in STATA

Table AP6: GDP Growth Rate, LSDV Model with Country-Clusters

```
reg act_gdp fc_gdp d_country2-d_country30 d_20002-d_20102, cluster(country)

Linear regression                                      Number of obs =     660
                                                       F( 21,    29) =       .
                                                       Prob > F      =       .
                                                       R-squared     =  0.6583
                                                       Root MSE      =  2.6692
                                  (Std. Err. adjusted for 30 clusters in country)
------------------------------------------------------------------------------
             |               Robust
     act_gdp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      fc_gdp |   .4629928   .2428202     1.91   0.067    -.0336303     .959616
  d_country2 |   2.498852   .0979007    25.52   0.000     2.298623    2.699082
  d_country3 |  -2.146118   .9826052    -2.18   0.037    -4.155772   -.1364648
  d_country4 |   2.733774   .6365974     4.29   0.000     1.431786    4.035762
  d_country5 |  -2.050865   1.020761    -2.01   0.054    -4.138556    .0368257
  d_country6 |  -.8628961   .4067239    -2.12   0.043     -1.69474   -.0310523
  d_country7 |  -2.356991   1.058122    -2.23   0.034    -4.521094   -.1928879
  d_country8 |  -1.061014   .3345732    -3.17   0.004    -1.745293   -.3767345
  d_country9 |  -1.883563   .8563829    -2.20   0.036    -3.635063   -.1320634
 d_country10 |  -2.416698   .9808945    -2.46   0.020    -4.422853   -.4105439
 d_country11 |   .7304478    .273835     2.67   0.012     .1703923    1.290503
 d_country12 |  -2.428313   1.084844    -2.24   0.033    -4.647068   -.2095592
 d_country13 |  -2.059325   .6754266    -3.05   0.005    -3.440728   -.6779227
 d_country14 |  -2.984928   1.092007    -2.73   0.011    -5.218333   -.7515233
 d_country15 |  -.8345055   .3598706    -2.32   0.028    -1.570524   -.0984874
 d_country16 |  -.7939792   .4226286    -1.88   0.070    -1.658352    .0703934
 d_country17 |  -1.240879   .6162778    -2.01   0.053    -2.501308    .0195509
 d_country18 |  -.0123265   .4802322    -0.03   0.980    -.9945116    .9698587
 d_country19 |   -2.44556   .9941502    -2.46   0.020    -4.478825    -.412294
 d_country20 |  -2.108367   .9491954    -2.22   0.034     -4.04969   -.1670447
 d_country21 |  -.7960777   .4978367    -1.60   0.121    -1.814268    .2221127
 d_country22 |  -2.879435   1.048211    -2.75   0.010    -5.023267   -.7356031
 d_country23 |  -.8389362   .4776716    -1.76   0.090    -1.815884    .1380119
 d_country24 |   .2814541   .4546809     0.62   0.541    -.6484728    1.211381
 d_country25 |  -1.821837   .8829386    -2.06   0.048     -3.62765   -.0160254
 d_country26 |  -1.757549   .9287654    -1.89   0.068    -3.657088    .1419894
 d_country27 |  -1.952212   1.094766    -1.78   0.085     -4.19126     .286836
 d_country28 |  -.7202148   .3897265    -1.85   0.075    -1.517295    .0768654
 d_country29 |   .0641692   .6225249     0.10   0.919    -1.209037    1.337375
 d_country30 |  -2.113117   .9851328    -2.15   0.040     -4.12794   -.0982943
     d_20002 |   .2638861   .1100094     2.40   0.023     .0388917    .4888806
     d_20011 |  -1.537985   .6164731    -2.49   0.019    -2.798814    -.277156
     d_20012 |  -1.596017   .7307712    -2.18   0.037    -3.090612   -.1014219
     d_20021 |  -1.394993   .5886242    -2.37   0.025    -2.598865   -.1911215
     d_20022 |  -1.110446   .5675764    -1.96   0.060     -2.27127    .0503781
     d_20031 |   -1.00632   .6823094    -1.47   0.151    -2.401799    .3891593
     d_20032 |  -.6588449   .7095361    -0.93   0.361    -2.110009    .7923193
     d_20041 |    .534058   .5238923     1.02   0.316     -.537422    1.605538
     d_20042 |   .6480108   .4766593     1.36   0.184    -.3268669    1.622889
     d_20051 |  -.0860681   .5656937    -0.15   0.880    -1.243042    1.070905
     d_20052 |  -.1079895   .5961983    -0.18   0.858    -1.327352    1.111373
     d_20061 |   .8652862   .5275269     1.64   0.112    -.2136275      1.9442
     d_20062 |   .9605355   .5152916     1.86   0.072    -.0933542    2.014425
     d_20071 |   .6494363   .6069677     1.07   0.293     -.591952    1.890825
     d_20072 |   .5292405   .6131322     0.86   0.395    -.7247558    1.783237
     d_20081 |  -2.473955   .7801038    -3.17   0.004    -4.069447    -.878464
     d_20082 |  -2.576814   .7590349    -3.39   0.002    -4.129215   -1.024413
     d_20091 |  -10.10398   1.089701    -9.27   0.000    -12.33266   -7.875287
     d_20092 |  -9.551682   1.056865    -9.04   0.000    -11.71321   -7.390151
     d_20101 |  -.0396551   .8436143    -0.05   0.963     -1.76504     1.68573
     d_20102 |  -.1926416   .8122441    -0.24   0.814    -1.853867    1.468584
       _cons |   3.951068   1.480676     2.67   0.012     .9227466     6.97939
```

Source: Author's computations in STATA

Table AP7: GDP Growth Rate, RE Model

```
xtreg act_gdp fc_gdp d_20002-d_20102, re

Random-effects GLS regression                   Number of obs      =       660
Group variable: country                         Number of groups   =        30

R-sq:  within  = 0.5746                         Obs per group: min =        22
       between = 0.7682                                        avg =      22.0
       overall = 0.5858                                        max =        22

Random effects u_i ~ Gaussian                   Wald chi2(22)      =    874.51
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
     act_gdp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      fc_gdp |   .7288486    .076958     9.47   0.000     .5780137    .8796835
     d_20002 |   .2946368   .7019867     0.42   0.675    -1.081232    1.670505
     d_20011 |  -1.680572   .7031428    -2.39   0.017    -3.058707    -.302438
     d_20012 |  -1.800637    .704425    -2.56   0.011    -3.181285   -.4199896
     d_20021 |  -1.553089   .7034206    -2.21   0.027    -2.931768   -.1744097
     d_20022 |  -1.177885   .7022017    -1.68   0.093    -2.554175    .1984054
     d_20031 |  -1.163264   .7033989    -1.65   0.098      -2.5419     .215373
     d_20032 |  -.7617311   .7025618    -1.08   0.278    -2.138727    .6152648
     d_20041 |    .446237   .7023905     0.64   0.525     -.930423    1.822897
     d_20042 |   .5796859   .7022089     0.83   0.409    -.7966182     1.95599
     d_20051 |  -.1969299   .7026635    -0.28   0.779    -1.574125    1.180265
     d_20052 |    -.28886   .7038802    -0.41   0.682     -1.66844     1.09072
     d_20061 |   .7207492   .7031761     1.02   0.305    -.6574506    2.098949
     d_20062 |   .8381533   .7028237     1.19   0.233    -.5393558    2.215662
     d_20071 |   .5004685   .7032536     0.71   0.477    -.8778833     1.87882
     d_20072 |   .3510285   .7038234     0.50   0.618     -1.02844    1.730497
     d_20081 |  -2.681412   .7044945    -3.81   0.000    -4.062195   -1.300628
     d_20082 |  -2.842758   .7061392    -4.03   0.000    -4.226766   -1.458751
     d_20091 |  -10.13181   .7019765   -14.43   0.000    -11.50766   -8.755962
     d_20092 |  -9.272835   .7065562   -13.12   0.000    -10.65766    -7.88801
     d_20101 |   .8323872   .7459412     1.12   0.264    -.6296307    2.294405
     d_20102 |   .5745383   .7362232     0.78   0.435    -.8684326    2.017509
       _cons |   1.939908   .5738154     3.38   0.001     .8152506    3.064566
-------------+----------------------------------------------------------------
     sigma_u |  .75279761
     sigma_e |  2.6692296
         rho |  .07367938   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Source: Author's computations in STATA

Table AP8: GDP Growth Rate, FE Model

```
xtreg act_gdp fc_gdp d_20002-d_20102, fe

Fixed-effects (within) regression               Number of obs      =       660
Group variable: country                         Number of groups   =        30

R-sq:  within  = 0.5799                         Obs per group: min =        22
       between = 0.7682                                        avg =      22.0
       overall = 0.5599                                        max =        22

                                                F(22,608)          =     38.14
corr(u_i, Xb)  = 0.1499                         Prob > F           =    0.0000

------------------------------------------------------------------------------
     act_gdp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      fc_gdp |   .4629928   .0925396     5.00   0.000     .2812569    .6447288
     d_20002 |   .2638861   .6892752     0.38   0.702    -1.089763    1.617535
     d_20011 |  -1.537985   .6909769    -2.23   0.026    -2.894976    -.180994
     d_20012 |  -1.596017   .6928627    -2.30   0.022    -2.956711   -.2353222
     d_20021 |  -1.394993   .6913856    -2.02   0.044    -2.752787   -.0371993
     d_20022 |  -1.110446   .6895918    -1.61   0.108    -2.464717     .243825
     d_20031 |   -1.00632   .6913538    -1.46   0.146    -2.364051    .3514113
     d_20032 |  -.6588449    .690122    -0.95   0.340    -2.014157    .6964672
     d_20041 |    .534058   .6898697     0.77   0.439    -.8207587    1.888875
     d_20042 |   .6480108   .6896023     0.94   0.348    -.7062808    2.002303
     d_20051 |  -.0860681   .6902716    -0.12   0.901    -1.441674    1.269538
     d_20052 |  -.1079895   .6920617    -0.16   0.876    -1.467111    1.251132
     d_20061 |   .8652862    .691026     1.25   0.211    -.4918014    2.222374
     d_20062 |   .9605355   .6905074     1.39   0.165    -.3955335    2.316605
     d_20071 |   .6494363     .69114     0.94   0.348    -.7078752    2.006748
     d_20072 |   .5292405   .6919782     0.76   0.445     -.829717    1.888198
     d_20081 |  -2.473955   .6929649    -3.57   0.000    -3.834851    -1.11306
     d_20082 |  -2.576814   .6953812    -3.71   0.000    -3.942455   -1.211173
     d_20091 |  -10.10398   .6892602   -14.66   0.000     -11.4576   -8.750356
     d_20092 |  -9.551682   .6959933   -13.72   0.000    -10.91853    -8.18484
     d_20101 |  -.0396551   .7530761    -0.05   0.958    -1.518601    1.439291
     d_20102 |  -.1926416    .739119    -0.26   0.794    -1.644178    1.258894
       _cons |   2.809168   .5736232     4.90   0.000     1.682644    3.935691
-------------+----------------------------------------------------------------
     sigma_u |  1.4143884
     sigma_e |  2.6692296
         rho |  .21922553   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(29, 608) =     4.14             Prob > F = 0.0000
```

Source: Author's computations in STATA

Table AP9: GDP Growth Rate, Test for Fixed Effects

```
. test d_20002 d_20011 d_20012 d_20021 d_20022 d_20031 d_20032 d_20041 d_20042
d_20051 d_20052 d_20061 d_20062 d_20071 d_20072 d_20081 d_20082 d_20091 d_20092
d_20101 d_20102

 ( 1)  d_20002 = 0
 ( 2)  d_20011 = 0
 ( 3)  d_20012 = 0
 ( 4)  d_20021 = 0
 ( 5)  d_20022 = 0
 ( 6)  d_20031 = 0
 ( 7)  d_20032 = 0
 ( 8)  d_20041 = 0
 ( 9)  d_20042 = 0
 (10)  d_20051 = 0
 (11)  d_20052 = 0
 (12)  d_20061 = 0
 (13)  d_20062 = 0
 (14)  d_20071 = 0
 (15)  d_20072 = 0
 (16)  d_20081 = 0
 (17)  d_20082 = 0
 (18)  d_20091 = 0
 (19)  d_20092 = 0
 (20)  d_20101 = 0
 (21)  d_20102 = 0

       F( 21,   608) =   36.64
            Prob > F =    0.0000
```

Source: Author's computations using STATA

Table AP10: GDP Growth Rate, Hausman Specification Test

```
hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+------------------------------------------------------------
      fc_gdp |    .4629928     .7288486       -.2658558         .051391
     d_20002 |    .2638861     .2946368       -.0307507               .
     d_20011 |   -1.537985    -1.680572        .1425873               .
     d_20012 |   -1.596017    -1.800637        .2046203               .
     d_20021 |   -1.394993    -1.553089        .1580956               .
     d_20022 |   -1.110446    -1.177885        .0674387               .
     d_20031 |    -1.00632    -1.163264        .1569435               .
     d_20032 |   -.6588449    -.7617311        .1028862               .
     d_20041 |     .534058     .446237         .087821               .
     d_20042 |    .6480108     .5796859        .0683249               .
     d_20051 |   -.0860681    -.1969299        .1108619               .
     d_20052 |   -.1079895     -.28886         .1808705               .
     d_20061 |    .8652862     .7207492        .1445369               .
     d_20062 |    .9605355     .8381533        .1223823               .
     d_20071 |    .6494363     .5004685        .1489678               .
     d_20072 |    .5292405     .3510285         .178212               .
     d_20081 |   -2.473955    -2.681412        .2074561               .
     d_20082 |   -2.576814    -2.842758        .2659444               .
     d_20091 |   -10.10398    -10.13181        .0278351               .
     d_20092 |   -9.551682    -9.272835       -.2788472               .
     d_20101 |   -.0396551     .8323872       -.8720423        .1034181
     d_20102 |   -.1926416     .5745383         -.76718        .0653627
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                 chi2(22) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       26.76
                Prob>chi2 =      0.2204
                (V_b-V_B is not positive definite)
```

Source: Author's computations in STATA

Table AP11: GDP Growth Rate, LSDV model: Test for Efficiency

Restriction set
1: b[const] = 0
2: b[Fc_GDP] = 1

Test statistic: F(2, 608) = 5.3478, with p-value = 0.00498509
Restricted estimates:

	coefficient	std. error	t-ratio	p-value	
const	0.000000	0.000000	NA	NA	
Fc_GDP	1.00000	0.000000	NA	NA	
d_2000_2	0.614537	0.626401	0.9811	0.3270	
d_2001_1	-1.53746	0.626401	-2.454	0.0144	**
d_2001_2	-1.72080	0.626401	-2.747	0.0062	***
d_2002_1	-1.42580	0.626401	-2.276	0.0232	**
d_2002_2	-0.958130	0.626401	-1.530	0.1266	
d_2003_1	-1.03480	0.626401	-1.652	0.0991	*
d_2003_2	-0.578130	0.626401	-0.9229	0.3564	
d_2004_1	0.645203	0.626401	1.030	0.3034	
d_2004_2	0.798537	0.626401	1.275	0.2029	
d_2005_1	-0.0214634	0.626401	-0.03426	0.9727	
d_2005_2	-0.184797	0.626401	-0.2950	0.7681	
d_2006_1	0.861870	0.626401	1.376	0.1694	
d_2006_2	1.00187	0.626401	1.599	0.1102	
d_2007_1	0.637070	0.626401	1.017	0.3095	
d_2007_2	0.457803	0.626401	0.7308	0.4652	
d_2008_1	-2.60446	0.626401	-4.158	3.67e-05	***
d_2008_2	-2.82546	0.626401	-4.511	7.75e-06	***
d_2009_1	-9.87166	0.626401	-15.76	3.42e-047	***
d_2009_2	-8.69990	0.626401	-13.89	2.64e-038	***
d_2010_1	2.01034	0.626401	3.209	0.0014	***
d_2010_2	1.64554	0.626401	2.627	0.0088	***
d_country2	3.10882	0.693942	4.480	8.92e-06	***
d_country3	0.420414	0.693942	0.6058	0.5449	
d_country4	4.53510	0.693942	6.535	1.34e-010	***
d_country5	0.600050	0.693942	0.8647	0.3875	
d_country6	0.430050	0.693942	0.6197	0.5357	
d_country7	0.376550	0.693942	0.5426	0.5876	
d_country8	0.0723681	0.693942	0.1043	0.9170	
d_country9	0.403823	0.693942	0.5819	0.5608	
d_country10	0.146050	0.693942	0.2105	0.8334	
d_country11	1.72950	0.693942	2.492	0.0130	**
d_country12	0.364323	0.693942	0.5250	0.5998	
d_country13	-0.172132	0.693942	-0.2480	0.8042	
d_country14	-0.176450	0.693942	-0.2543	0.7994	
d_country15	0.354823	0.693942	0.5113	0.6093	
d_country16	0.534141	0.693942	0.7697	0.4418	
d_country17	0.515504	0.693942	0.7429	0.4579	
d_country18	1.44319	0.693942	2.080	0.0380	**
d_country19	0.146504	0.693942	0.2111	0.8329	
d_country20	0.384277	0.693942	0.5538	0.5799	
d_country21	0.698368	0.693942	1.006	0.3146	
d_country22	-0.167814	0.693942	-0.2418	0.8090	
d_country23	0.610914	0.693942	0.8804	0.3790	
d_country24	1.68046	0.693942	2.422	0.0157	**
d_country25	0.524277	0.693942	0.7555	0.4502	
d_country26	0.689914	0.693942	0.9942	0.3205	
d_country27	0.862368	0.693942	1.243	0.2145	
d_country28	0.535141	0.693942	0.7712	0.4409	
d_country29	1.83437	0.693942	2.643	0.0084	***
d_country30	0.459004	0.693942	0.6614	0.5086	

Standard error of the regression = 2.73939

Source: Author's computations in STATA

Table AP12: GDP Growth Rate, RE Model: Test for Efficiency

```
Restriction set
 1: b[const] = 0
 2: b[Fc_GDP] = 1

Test statistic: F(2, 637) = 8.29302, with p-value = 0.000278277
```

Source: Author's computations in GRETL

Table AP13: GDP Growth Rate, Forecast Errors per country

Country	Average Error	Sum of Errors	Maximum Error	Minimum Error
	$\frac{\sum_{t=1}^{22} e_t}{22}$	$\sum_{t=1}^{22} e_t$	$max\ (e_t)$	$min\ (e_t)$
Albania	-0.6424	-14.134	1.500	-3.300
Armenia	2.0729	45.604	7.900	-22.423
Austria	-0.6155	-13.541	1.825	-5.283
Belarus	3.4991	76.982	7.800	-7.794
Belgium	-0.4358	-9.589	2.065	-4.182
Bulgaria	-0.6058	-13.329	2.650	-9.832
Denmark	-0.6593	-14.506	1.681	-5.606
Estonia	-0.9635	-21.198	5.900	-17.795
Finland	-0.6321	-13.906	4.360	-9.871
France	-0.8899	-19.577	1.074	-3.428
Georgia	0.6936	15.259	7.400	-13.000
Germany	-0.6716	-14.775	4.504	-6.010
Hungary	-1.2080	-26.577	2.076	-8.831
Italy	-1.2124	-26.672	1.685	-5.289
Latvia	-0.6811	-14.984	5.700	-18.469
Lithuania	-0.5018	-11.039	5.322	-20.461
Luxembourg	-0.5204	-11.449	4.100	-7.408
Moldova	0.4072	8.960	6.900	-14.490
Netherlands	-0.8894	-19.567	2.408	-5.535
Norway	-0.6516	-14.336	0.916	-3.862
Poland	-0.3375	-7.426	2.720	-4.500
Portugal	-1.2037	-26.482	1.898	-4.078
Romania	-0.4250	-9.350	3.300	-11.935
Russia	0.6445	14.180	7.470	-14.200
Spain	-0.5116	-11.256	0.900	-5.299
Sweden	-0.3460	-7.612	5.366	-6.544
Switzerland	-0.1735	-3.818	2.882	-3.100
Turkey	-0.5007	-11.017	6.700	-12.910
UK	-0.5769	-12.692	1.647	-6.530
Ukraine	0.7984	17.566	8.100	-19.259
TOTAL	**-0.2580**	**-170.281**	-	-

Source: Author's computations in Excel

Table AP14: GDP Growth Rate, LSDV Model: Test for Unbiasedness

```
Pooled OLS, using 660 observations
Included 30 cross-sectional units
Time-series length = 22
Dependent variable: Fc_Error_GDP

                   coefficient   std. error   t-ratio    p-value
  ------------------------------------------------------------------
  const             -0.258002    0.121616     -2.121    0.0343    **
  GDP_resid_LSDV     1.00000     0.0474706    21.07     1.09e-075 ***

Mean dependent var  -0.258002   S.D. dependent var   4.039833
Sum squared resid    6423.177   S.E. of regression   3.124367
R-squared            0.402776   Adjusted R-squared   0.401868
F(1, 658)            443.7633   P-value(F)           1.09e-75
Log-likelihood      -1687.391   Akaike criterion     3378.782
Schwarz criterion    3387.766   Hannan-Quinn         3382.264
rho                  0.551098   Durbin-Watson        0.881838

  ------------------------------------------------------------------

Restriction:
 b[const] = 0

Test statistic: F(1, 658) = 4.50054, with p-value = 0.0342574

Restricted estimates:

                   coefficient   std. error   t-ratio    p-value
  ------------------------------------------------------------------
  const             0.000000     0.000000      NA       NA
  GDP_resid_LSDV    1.00000      0.0475965     21.01     2.09e-075 ***

  Standard error of the regression = 3.13265
```

Source: Author's computations in GRETL

Table AP15: GDP Growth Rate, RE Model: Test for Unbiasedness

```
Pooled OLS, using 660 observations
Included 30 cross-sectional units
Time-series length = 22
Dependent variable: Fc_Error_GDP

                 coefficient   std. error   t-ratio    p-value
  ------------------------------------------------------------
  const           -0.258002    0.114566     -2.252    0.0247    **
  Resid_GDP_RE     0.980058    0.0405716    24.16     8.73e-093 ***

Mean dependent var  -0.258002   S.D. dependent var   4.039833
Sum squared resid    5700.105   S.E. of regression   2.943259
R-squared            0.470006   Adjusted R-squared   0.469201
F(1, 658)            583.5246   P-value(F)           8.73e-93
Log-likelihood      -1647.979   Akaike criterion     3299.959
Schwarz criterion    3308.943   Hannan-Quinn         3303.441
rho                  0.507063   Durbin-Watson        0.976103

  ------------------------------------------------------------

Restriction:
 b[const] = 0

Test statistic: F(1, 658) = 5.07144, with p-value = 0.0246521

Restricted estimates:

                 coefficient   std. error   t-ratio    p-value
  ------------------------------------------------------------
  const           0.000000     0.000000      NA       NA
  Resid_GDP_RE    0.980058     0.0406967     24.08     2.08e-092 ***

  Standard error of the regression = 2.95234
```

Source: Author's computations in GRETL

Table AP16: Inflation Rate, POLS Model

```
reg act_infl fc_infl d_20002-d_20102

      Source |       SS       df       MS              Number of obs =     660
-------------+------------------------------           F( 22,   637) =   47.43
       Model |  59634.4006    22  2710.65457           Prob > F      =  0.0000
    Residual |  36402.4182   637  57.1466533           R-squared     =  0.6210
-------------+------------------------------           Adj R-squared =  0.6079
       Total |  96036.8188   659  145.731136           Root MSE      =  7.5595

------------------------------------------------------------------------------
    act_infl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     fc_infl |   .7190154   .0235527    30.53   0.000     .6727651    .7652658
     d_20002 |  -4.588277   1.957643    -2.34   0.019    -8.432491   -.7440631
     d_20011 |  -6.369828   1.952339    -3.26   0.001    -10.20363    -2.53603
     d_20012 |  -5.127632   1.951866    -2.63   0.009    -8.960502   -1.294761
     d_20021 |   -6.18582   1.952487    -3.17   0.002    -10.01991   -2.351731
     d_20022 |  -6.693855   1.952164    -3.43   0.001    -10.52731     -2.8604
     d_20031 |  -7.373159   1.952756    -3.78   0.000    -11.20778   -3.538542
     d_20032 |  -7.521755   1.952615    -3.85   0.000    -11.35609   -3.687415
     d_20041 |  -7.078413   1.953612    -3.62   0.000    -10.91471   -3.242115
     d_20042 |  -7.226486   1.953422    -3.70   0.000    -11.06241   -3.390562
     d_20051 |  -7.034938   1.954183    -3.60   0.000    -10.87236   -3.197518
     d_20052 |  -7.252103   1.953845    -3.71   0.000    -11.08886   -3.415347
     d_20061 |  -7.225351   1.954199    -3.70   0.000     -11.0628   -3.387901
     d_20062 |  -7.459129   1.953662    -3.82   0.000    -11.29553   -3.622732
     d_20071 |  -6.811662   1.953909    -3.49   0.001    -10.64854    -2.97478
     d_20072 |  -7.045454   1.953585    -3.61   0.000     -10.8817   -3.209207
     d_20081 |  -4.332372   1.953884    -2.22   0.027    -8.169205     -.49554
     d_20082 |  -4.687087    1.95339    -2.40   0.017     -8.52295   -.8512236
     d_20091 |  -8.941228   1.953424    -4.58   0.000    -12.77716     -5.1053
     d_20092 |  -9.521504   1.952769    -4.88   0.000    -13.35615   -5.686861
     d_20101 |  -7.014815   1.955667    -3.59   0.000    -10.85515   -3.174482
     d_20102 |  -7.114289   1.955521    -3.64   0.000    -10.95434   -3.274241
       _cons |   8.818274   1.391626     6.34   0.000     6.085544      11.551
------------------------------------------------------------------------------
```

Source: Author's computations in STATA

Table AP17: Inflation Rate, POLS Model with Robust Errors

```
reg act_infl fc_infl d_20002-d_20102, robust

Linear regression                                      Number of obs =     660
                                                       F( 22,   637) =    9.39
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.6210
                                                       Root MSE      =  7.5595

------------------------------------------------------------------------------
             |               Robust
    act_infl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     fc_infl |   .7190154   .0813452     8.84   0.000     .5592783    .8787526
     d_20002 |  -4.588277   5.507682    -0.83   0.405    -15.40369    6.227131
     d_20011 |  -6.369828   5.515491    -1.15   0.249    -17.20057    4.460914
     d_20012 |  -5.127632   5.262264    -0.97   0.330    -15.46111    5.205851
     d_20021 |   -6.18582   5.133894    -1.20   0.229    -16.26722    3.895583
     d_20022 |  -6.693855   5.129076    -1.31   0.192     -16.7658    3.378086
     d_20031 |  -7.373159   4.998044    -1.48   0.141    -17.18779    2.441477
     d_20032 |  -7.521755   4.998726    -1.50   0.133    -17.33773    2.294219
     d_20041 |  -7.078413   4.958699    -1.43   0.154    -16.81579    2.658959
     d_20042 |  -7.226486   4.961931    -1.46   0.146    -16.97021    2.517234
     d_20051 |  -7.034938   4.949125    -1.42   0.156    -16.75351    2.683634
     d_20052 |  -7.252103   4.956226    -1.46   0.144    -16.98462    2.480413
     d_20061 |  -7.225351   4.942533    -1.46   0.144    -16.93098    2.480277
     d_20062 |  -7.459129   4.949448    -1.51   0.132    -17.17834    2.260077
     d_20071 |  -6.811662   4.952858    -1.38   0.170    -16.53756    2.914241
     d_20072 |  -7.045454   4.953555    -1.42   0.155    -16.77273    2.681818
     d_20081 |  -4.332372   4.995482    -0.87   0.386    -14.14198    5.477231
     d_20082 |  -4.687087   4.989974    -0.94   0.348    -14.48587    5.111701
     d_20091 |  -8.941228   4.970249    -1.80   0.072    -18.70128    .8188244
     d_20092 |  -9.521504   4.985762    -1.91   0.057    -19.31202    .2690127
     d_20101 |  -7.014815   4.906981    -1.43   0.153    -16.65063    2.620999
     d_20102 |  -7.114289   4.910704    -1.45   0.148    -16.75741    2.528837
       _cons |   8.818274   4.852268     1.82   0.070    -.7101006    18.34665
------------------------------------------------------------------------------
```

Source: Author's computations in STATA

Table AP18: Inflation Rate, VIF Test for POLS Model

```
vif

    Variable |       VIF       1/VIF
-------------+----------------------
     d_20002 |      1.92    0.520722
     d_20101 |      1.92    0.521775
     d_20102 |      1.92    0.521853
     d_20061 |      1.91    0.522559
     d_20051 |      1.91    0.522567
     d_20071 |      1.91    0.522714
     d_20081 |      1.91    0.522728
     d_20052 |      1.91    0.522748
     d_20062 |      1.91    0.522846
     d_20041 |      1.91    0.522873
     d_20072 |      1.91    0.522887
     d_20091 |      1.91    0.522974
     d_20042 |      1.91    0.522975
     d_20082 |      1.91    0.522992
     d_20092 |      1.91    0.523325
     d_20031 |      1.91    0.523332
     d_20032 |      1.91    0.523407
     d_20021 |      1.91    0.523476
     d_20011 |      1.91    0.523555
     d_20022 |      1.91    0.523649
     d_20012 |      1.91    0.523809
     fc_infl |      1.04    0.960808
-------------+----------------------
    Mean VIF |      1.87
```

Source: Author's computations in STATA

Table AP19: Inflation Rate, LSDV Model with Year & Country-Dummies

```
reg act_infl fc_infl d_20002-d_20102 d_country2-d_country30

      Source |       SS       df       MS              Number of obs =     660
-------------+------------------------------           F( 51,   608) =   25.56
       Model |   65492.427    51  1284.16523            Prob > F      =  0.0000
    Residual |  30544.3919   608  50.2374866            R-squared     =  0.6820
-------------+------------------------------           Adj R-squared =  0.6553
       Total |  96036.8188   659  145.731136            Root MSE      =  7.0878

------------------------------------------------------------------------------
    act_infl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     fc_infl |   .5819715     .02622    22.20   0.000     .5304788    .6334642
     d_20002 |  -3.713754   1.837705    -2.02   0.044    -7.322775   -.1047337
     d_20011 |  -6.119541   1.830699    -3.34   0.001    -9.714802    -2.52428
     d_20012 |   -5.11347   1.830075    -2.79   0.005    -8.707505   -1.519436
     d_20021 |  -6.472516   1.830894    -3.54   0.000    -10.06816   -2.876871
     d_20022 |  -6.892614   1.830468    -3.77   0.000    -10.48742   -3.297807
     d_20031 |  -7.716271    1.83125    -4.21   0.000    -11.31261   -4.119928
     d_20032 |  -7.836545   1.831063    -4.28   0.000    -11.43252   -4.240568
     d_20041 |  -7.559026   1.832381    -4.13   0.000    -11.15759   -3.960461
     d_20042 |  -7.680147    1.83213    -4.19   0.000    -11.27822   -4.082076
     d_20051 |  -7.588641   1.833136    -4.14   0.000    -11.18869   -3.988594
     d_20052 |  -7.763779   1.832689    -4.24   0.000    -11.36295    -4.16461
     d_20061 |  -7.780882   1.833156    -4.24   0.000    -11.38097   -4.180794
     d_20062 |  -7.946594   1.832448    -4.34   0.000    -11.54529   -4.347899
     d_20071 |  -7.331561   1.832774    -4.00   0.000     -10.9309   -3.732225
     d_20072 |  -7.522412   1.832346    -4.11   0.000    -11.12091   -3.923916
     d_20081 |  -4.849074   1.832741    -2.65   0.008    -8.448344   -1.249803
     d_20082 |  -5.136179   1.832089    -2.80   0.005    -8.734169   -1.538189
     d_20091 |  -9.395186   1.832132    -5.13   0.000    -12.99326    -5.79711
     d_20092 |  -9.867174   1.831267    -5.39   0.000    -13.46355   -6.270797
     d_20101 |  -7.723994   1.835096    -4.21   0.000    -11.32789   -4.120099
     d_20102 |   -7.80975   1.834903    -4.26   0.000    -11.41327   -4.206232
  d_country2 |   .7329028   2.137158     0.34   0.732    -3.464205    4.930011
  d_country3 |   .0156065   2.137454     0.01   0.994    -4.182083    4.213296
  d_country4 |   13.03781   2.298773     5.67   0.000     8.523311    17.55231
  d_country5 |   .2849364   2.137463     0.13   0.894     -3.91277    4.482643
  d_country6 |   3.015224   2.137197     1.41   0.159     -1.18196    7.212407
  d_country7 |   .0148715   2.137276     0.01   0.994    -4.182467     4.21221
  d_country8 |   1.459678   2.137065     0.68   0.495    -2.737246    5.656602
  d_country9 |  -.1429233    2.13737    -0.07   0.947    -4.340448    4.054601
 d_country10 |   .0398185   2.137494     0.02   0.985     -4.15795    4.237587
 d_country11 |   2.055204   2.137789     0.96   0.337    -2.143142    6.253551
 d_country12 |   .0767957   2.137585     0.04   0.971    -4.121151    4.274742
 d_country13 |   2.242461   2.137484     1.05   0.295    -1.955287    6.440208
 d_country14 |    .447136   2.137302     0.21   0.834    -3.750255    4.644527
 d_country15 |   2.015276   2.137122     0.94   0.346    -2.181761    6.212313
 d_country16 |   .2788293   2.137083     0.13   0.896     -3.91813    4.475789
 d_country17 |   .3928572    2.13733     0.18   0.854    -3.804588    4.590302
 d_country18 |   6.013859    2.14085     2.81   0.005     1.809502    10.21822
 d_country19 |   .1622903   2.137346     0.08   0.939    -4.035186    4.359766
 d_country20 |  -.1288408   2.137196    -0.06   0.952    -4.326023    4.068341
 d_country21 |   .3523004   2.137106     0.16   0.869    -3.844706    4.549306
 d_country22 |   .3284668   2.137238     0.15   0.878    -3.868798    4.525732
 d_country23 |   8.075805   2.147096     3.76   0.000     3.859181    12.29243
 d_country24 |   5.582029   2.148554     2.60   0.010     1.362541    9.801516
 d_country25 |   .5395927   2.137138     0.25   0.801    -3.657475     4.73666
 d_country26 |  -.1886457   2.137333    -0.09   0.930    -4.386097    4.008805
 d_country27 |  -.5858485   2.137798    -0.27   0.784    -4.784214    3.612517
 d_country28 |   11.21001   2.167318     5.17   0.000     6.953669    15.46635
 d_country29 |   5.655815    2.14622     2.64   0.009     1.440912    9.870719
 d_country30 |   .0709803   2.137221     0.03   0.974    -4.126252    4.268213
       _cons |   7.753018   1.975602     3.92   0.000     3.873186    11.63285
------------------------------------------------------------------------------
```

```
. test d_country30 d_country29 d_country28 d_country27 d_country26 d_country25
d_country24 d_country23 d_country22 d_country21 d_country20 d_country19
d_country18 d_country17 d_country16 d_country15 d_country14 d_country13
d_country12 d_country11 d_country10 d_country9 d_country8 d_country7 d_country6
d_country5 d_country4 d_country3 d_country2

 ( 1)  d_country30 = 0
 ( 2)  d_country29 = 0
 ( 3)  d_country28 = 0
 ( 4)  d_country27 = 0
 ( 5)  d_country26 = 0
 ( 6)  d_country25 = 0
 ( 7)  d_country24 = 0
 ( 8)  d_country23 = 0
 ( 9)  d_country22 = 0
 (10)  d_country21 = 0
 (11)  d_country20 = 0
 (12)  d_country19 = 0
 (13)  d_country18 = 0
 (14)  d_country17 = 0
 (15)  d_country16 = 0
 (16)  d_country15 = 0
 (17)  d_country14 = 0
 (18)  d_country13 = 0
 (19)  d_country12 = 0
 (20)  d_country11 = 0
 (21)  d_country10 = 0
 (22)  d_country9 = 0
 (23)  d_country8 = 0
 (24)  d_country7 = 0
 (25)  d_country6 = 0
 (26)  d_country5 = 0
 (27)  d_country4 = 0
 (28)  d_country3 = 0
 (29)  d_country2 = 0

       F( 29,   608) =    4.02
            Prob > F =    0.0000
```

Source: Author's computations in STATA

Table AP20: Inflation Rate, LSDV Model with Country-Clusters

```
reg act_infl fc_infl d_20002-d_20102 d_country2-d_country30, cluster(country)

Linear regression                                      Number of obs =     660
                                                       F( 21,    29) =       .
                                                       Prob > F      =       .
                                                       R-squared     =  0.6820
                                                       Root MSE      =  7.0878
                                  (Std. Err. adjusted for 30 clusters in country)
------------------------------------------------------------------------------
             |               Robust
    act_infl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     fc_infl |   .5819715   .0293541    19.83   0.000     .5219356    .6420075
     d_20002 |  -3.713754   4.345896    -0.85   0.400    -12.60211    5.174601
     d_20011 |  -6.119541   6.287992    -0.97   0.338    -18.97993    6.740848
     d_20012 |   -5.11347   5.092633    -1.00   0.324    -15.52908    5.302134
     d_20021 |  -6.472516   4.589269    -1.41   0.169    -15.85863    2.913594
     d_20022 |  -6.892614   4.578186    -1.51   0.143    -16.25606    2.470827
     d_20031 |  -7.716271   4.914999    -1.57   0.127    -17.76857     2.33603
     d_20032 |  -7.836545   4.919945    -1.59   0.122    -17.89896    2.225873
     d_20041 |  -7.559026   5.216514    -1.45   0.158      -18.228    3.109944
     d_20042 |  -7.680147   5.307327    -1.45   0.159    -18.53485    3.174554
     d_20051 |  -7.588641   5.377588    -1.41   0.169    -18.58704    3.409761
     d_20052 |  -7.763779    5.44222    -1.43   0.164    -18.89437    3.366811
     d_20061 |  -7.780882   5.456945    -1.43   0.165    -18.94159    3.379824
     d_20062 |  -7.946594   5.498358    -1.45   0.159      -19.192    3.298811
     d_20071 |  -7.331561   5.489772    -1.34   0.192     -18.5594    3.896283
     d_20072 |  -7.522412   5.396252    -1.39   0.174    -18.55899    3.514162
     d_20081 |  -4.849074   5.359863    -0.90   0.373    -15.81122    6.113077
     d_20082 |  -5.136179   5.242774    -0.98   0.335    -15.85886    5.586497
     d_20091 |  -9.395186   5.182977    -1.81   0.080    -19.99557    1.205193
     d_20092 |  -9.867174    5.17985    -1.90   0.067    -20.46116    .7268085
     d_20101 |  -7.723994   5.393682    -1.43   0.163    -18.75531    3.307324
     d_20102 |   -7.80975   5.450226    -1.43   0.163    -18.95671    3.337214
  d_country2 |   .7329028   .0223999    32.72   0.000        .68709    .7787157
  d_country3 |   .0156065   .0457124     0.34   0.735    -.0778858    .1090989
  d_country4 |   13.03781   .9481824    13.75   0.000     11.09856    14.97706
  d_country5 |   .2849364   .0461967     6.17   0.000     .1904535    .3794193
  d_country6 |   3.015224   .0266229   113.26   0.000     2.960774    3.069674
  d_country7 |   .0148715   .0336318     0.44   0.662    -.0539133    .0836563
  d_country8 |   1.459678   .0008206  1778.84   0.000        1.458    1.461356
  d_country9 |  -.1429233   .0404767    -3.53   0.001    -.2257074   -.0601392
 d_country10 |   .0398185    .048002     0.83   0.414    -.0583566    .1379936
 d_country11 |   2.055204   .0622935    32.99   0.000       1.9278    2.182609
 d_country12 |   .0767957   .0528201     1.45   0.157    -.0312335    .1848249
 d_country13 |   2.242461   .0474056    47.30   0.000     2.145505    2.339416
 d_country14 |    .447136   .0356879    12.53   0.000     .3741459     .520126
 d_country15 |   2.015276   .0175458   114.86   0.000     1.979391    2.051161
 d_country16 |   .2788293   .0098843    28.21   0.000     .2586135     .299045
 d_country17 |   .3928572    .037696    10.42   0.000     .3157602    .4699543
 d_country18 |   6.013859   .1424609    42.21   0.000     5.722494    6.305224
 d_country19 |   .1622903   .0388115     4.18   0.000     .0829119    .2416687
 d_country20 |  -.1288408   .0265321    -4.86   0.000    -.1831051   -.0745765
 d_country21 |   .3523004   .0149653    23.54   0.000      .321693    .3829078
 d_country22 |   .3284668   .0305163    10.76   0.000      .266054    .3908796
 d_country23 |   8.075805   .2320871    34.80   0.000     7.601134    8.550476
 d_country24 |   5.582029   .2484226    22.47   0.000     5.073947     6.09011
 d_country25 |   .5395927    .019802    27.25   0.000      .499093    .5800924
 d_country26 |  -.1886457   .0379229    -4.97   0.000    -.2662067   -.1110847
 d_country27 |  -.5858485   .0627058    -9.34   0.000    -.7140961   -.4576008
 d_country28 |   11.21001   .4040009    27.75   0.000     10.38373    12.03628
 d_country29 |   5.655815   .2216984    25.51   0.000     5.202391     6.10924
 d_country30 |   .0709803   .0289992     2.45   0.021     .0116703    .1302904
       _cons |   7.753018   5.028346     1.54   0.134    -2.531104    18.03714
```

Source: Author's computations in STATA

Table AP21: Inflation Rate, VIF Test for the LSDV Model

```
vif

    Variable |       VIF       1/VIF
-------------+----------------------
  d_country4 |      2.24    0.447030
 d_country28 |      1.99    0.502902
 d_country24 |      1.95    0.511724
 d_country23 |      1.95    0.512419
 d_country29 |      1.95    0.512838
 d_country18 |      1.94    0.515414
 d_country27 |      1.93    0.516886
 d_country11 |      1.93    0.516891
 d_country12 |      1.93    0.516989
 d_country10 |      1.93    0.517033
 d_country13 |      1.93    0.517038
  d_country5 |      1.93    0.517049
  d_country3 |      1.93    0.517053
  d_country9 |      1.93    0.517093
 d_country19 |      1.93    0.517105
 d_country26 |      1.93    0.517111
 d_country17 |      1.93    0.517113
 d_country14 |      1.93    0.517126
  d_country7 |      1.93    0.517139
 d_country22 |      1.93    0.517157
 d_country30 |      1.93    0.517165
  d_country6 |      1.93    0.517177
 d_country20 |      1.93    0.517178
  d_country2 |      1.93    0.517196
 d_country25 |      1.93    0.517206
 d_country15 |      1.93    0.517214
 d_country21 |      1.93    0.517221
 d_country16 |      1.93    0.517233
  d_country8 |      1.93    0.517241
     d_20002 |      1.93    0.519467
     d_20101 |      1.92    0.520946
     d_20102 |      1.92    0.521055
     d_20061 |      1.92    0.522049
     d_20051 |      1.92    0.522060
     d_20071 |      1.91    0.522267
     d_20081 |      1.91    0.522285
     d_20052 |      1.91    0.522315
     d_20062 |      1.91    0.522453
     d_20041 |      1.91    0.522490
     d_20072 |      1.91    0.522510
     d_20091 |      1.91    0.522632
     d_20042 |      1.91    0.522634
     d_20082 |      1.91    0.522657
     d_20092 |      1.91    0.523126
     d_20031 |      1.91    0.523136
     d_20032 |      1.91    0.523243
     d_20021 |      1.91    0.523339
     d_20011 |      1.91    0.523451
     d_20022 |      1.91    0.523583
     d_20012 |      1.91    0.523808
     fc_infl |      1.47    0.681540
-------------+----------------------
    Mean VIF |      1.92
```

Source: Author's computations in STATA

Table AP22: Inflation Rate, RE Model

```
xtreg act_infl fc_infl d_20002-d_20102, re

Random-effects GLS regression                   Number of obs      =       660
Group variable: country                         Number of groups   =        30

R-sq:  within  = 0.5015                         Obs per group: min =        22
       between = 0.9669                                        avg =      22.0
       overall = 0.6210                                        max =        22

Random effects u_i ~ Gaussian                   Wald chi2(22)      =   1043.53
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
    act_infl |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     fc_infl |   .7190154   .0235527    30.53   0.000     .6728529    .7651779
     d_20002 |  -4.588277   1.957643    -2.34   0.019    -8.425187   -.7513673
     d_20011 |  -6.369828   1.952339    -3.26   0.001    -10.19634   -2.543314
     d_20012 |  -5.127632   1.951866    -2.63   0.009     -8.95322   -1.302044
     d_20021 |   -6.18582   1.952487    -3.17   0.002    -10.01262   -2.359016
     d_20022 |  -6.693855   1.952164    -3.43   0.001    -10.52003   -2.867684
     d_20031 |  -7.373159   1.952756    -3.78   0.000    -11.20049   -3.545828
     d_20032 |  -7.521755   1.952615    -3.85   0.000    -11.34881   -3.694701
     d_20041 |  -7.078413   1.953612    -3.62   0.000    -10.90742   -3.249404
     d_20042 |  -7.226486   1.953422    -3.70   0.000    -11.05512    -3.39785
     d_20051 |  -7.034938   1.954183    -3.60   0.000    -10.86507   -3.204809
     d_20052 |  -7.252103   1.953845    -3.71   0.000    -11.08157   -3.422637
     d_20061 |  -7.225351   1.954199    -3.70   0.000    -11.05551   -3.395192
     d_20062 |  -7.459129   1.953662    -3.82   0.000    -11.28824   -3.630022
     d_20071 |  -6.811662   1.953909    -3.49   0.000    -10.64125   -2.982071
     d_20072 |  -7.045454   1.953585    -3.61   0.000    -10.87441   -3.216496
     d_20081 |  -4.332372   1.953884    -2.22   0.027    -8.161915   -.5028302
     d_20082 |  -4.687087    1.95339    -2.40   0.016    -8.515661   -.8585119
     d_20091 |  -8.941228   1.953424    -4.58   0.000    -12.76987   -5.112588
     d_20092 |  -9.521504   1.952769    -4.88   0.000    -13.34886   -5.694147
     d_20101 |  -7.014815   1.955667    -3.59   0.000    -10.84785   -3.181779
     d_20102 |  -7.114289   1.955521    -3.64   0.000    -10.94704   -3.281538
       _cons |   8.818274   1.391626     6.34   0.000     6.090736    11.54581
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  7.0878408
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
. estimates store random
```

Source: Author's computations in STATA

Table AP23: Inflation Rate, FE Model

```
xtreg act_infl fc_infl d_20002-d_20102, fe

Fixed-effects (within) regression               Number of obs      =       660
Group variable: country                         Number of groups   =        30

R-sq:  within  = 0.5047                         Obs per group: min =        22
       between = 0.9669                                        avg =      22.0
       overall = 0.6178                                        max =        22

                                                F(22,608)          =     28.16
corr(u_i, Xb)  = 0.4582                         Prob > F           =    0.0000

------------------------------------------------------------------------------
    act_infl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     fc_infl |   .5819715     .02622    22.20   0.000     .5304788    .6334642
     d_20002 |  -3.713754   1.837705    -2.02   0.044    -7.322775   -.1047337
     d_20011 |  -6.119541   1.830699    -3.34   0.001    -9.714802    -2.52428
     d_20012 |   -5.11347   1.830075    -2.79   0.005    -8.707505   -1.519436
     d_20021 |  -6.472516   1.830894    -3.54   0.000    -10.06816   -2.876871
     d_20022 |  -6.892614   1.830468    -3.77   0.000    -10.48742   -3.297807
     d_20031 |  -7.716271    1.83125    -4.21   0.000    -11.31261   -4.119928
     d_20032 |  -7.836545   1.831063    -4.28   0.000    -11.43252   -4.240568
     d_20041 |  -7.559026   1.832381    -4.13   0.000    -11.15759   -3.960461
     d_20042 |  -7.680147    1.83213    -4.19   0.000    -11.27822   -4.082076
     d_20051 |  -7.588641   1.833136    -4.14   0.000    -11.18869   -3.988594
     d_20052 |  -7.763779   1.832689    -4.24   0.000    -11.36295    -4.16461
     d_20061 |  -7.780882   1.833156    -4.24   0.000    -11.38097   -4.180794
     d_20062 |  -7.946594   1.832448    -4.34   0.000    -11.54529   -4.347899
     d_20071 |  -7.331561   1.832774    -4.00   0.000     -10.9309   -3.732225
     d_20072 |  -7.522412   1.832346    -4.11   0.000    -11.12091   -3.923916
     d_20081 |  -4.849074   1.832741    -2.65   0.008    -8.448344   -1.249803
     d_20082 |  -5.136179   1.832089    -2.80   0.005    -8.734169   -1.538189
     d_20091 |  -9.395186   1.832132    -5.13   0.000    -12.99326    -5.79711
     d_20092 |  -9.867174   1.831267    -5.39   0.000    -13.46355   -6.270797
     d_20101 |  -7.723994   1.835096    -4.21   0.000    -11.32789   -4.120099
     d_20102 |   -7.80975   1.834903    -4.26   0.000    -11.41327   -4.206232
       _cons |   9.854828   1.309165     7.53   0.000     7.283794    12.42586
-------------+----------------------------------------------------------------
     sigma_u |  3.4949115
     sigma_e |  7.0878408
         rho |  .19558105   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(29, 608) =     4.02             Prob > F = 0.0000

. estimates store fixed
```

Source: Author's computations in STATA

Table AP24: Inflation Rate, Test for Fixed Effects

```
. test d_20002 d_20011 d_20012 d_20021 d_20022 d_20031 d_20032 d_20041 d_20042
d_20051 d_20052 d_20061 d_20062 d_20071 d_20072 d_20081 d_20082 d_20091 d_20092
d_20101 d_20102

 ( 1)  d_20002 = 0
 ( 2)  d_20011 = 0
 ( 3)  d_20012 = 0
 ( 4)  d_20021 = 0
 ( 5)  d_20022 = 0
 ( 6)  d_20031 = 0
 ( 7)  d_20032 = 0
 ( 8)  d_20041 = 0
 ( 9)  d_20042 = 0
 (10)  d_20051 = 0
 (11)  d_20052 = 0
 (12)  d_20061 = 0
 (13)  d_20062 = 0
 (14)  d_20071 = 0
 (15)  d_20072 = 0
 (16)  d_20081 = 0
 (17)  d_20082 = 0
 (18)  d_20091 = 0
 (19)  d_20092 = 0
 (20)  d_20101 = 0
 (21)  d_20102 = 0

       F( 21,   608) =    2.56
            Prob > F =    0.0002
```

Source: Author's computations using STATA

Table AP25: Inflation Rate, Hausman Specification Test

```
hausman fixed random

                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+------------------------------------------------------------
     fc_infl |    .5819715     .7190154       -.1370439         .011522
     d_20002 |   -3.713754    -4.588277        .8745227               .
     d_20011 |   -6.119541    -6.369828        .2502878               .
     d_20012 |    -5.11347    -5.127632        .0141612               .
     d_20021 |   -6.472516     -6.18582       -.2866958               .
     d_20022 |   -6.892614    -6.693855       -.1987593               .
     d_20031 |   -7.716271    -7.373159       -.3431122               .
     d_20032 |   -7.836545    -7.521755       -.3147898               .
     d_20041 |   -7.559026    -7.078413       -.4806129               .
     d_20042 |   -7.680147    -7.226486       -.4536609               .
     d_20051 |   -7.588641    -7.034938        -.553703               .
     d_20052 |   -7.763779    -7.252103       -.5116762               .
     d_20061 |   -7.780882    -7.225351       -.5555302               .
     d_20062 |   -7.946594    -7.459129       -.4874651               .
     d_20071 |   -7.331561    -6.811662       -.5198988               .
     d_20072 |   -7.522412    -7.045454       -.4769584               .
     d_20081 |   -4.849074    -4.332372       -.5167011               .
     d_20082 |   -5.136179    -4.687087       -.4490928               .
     d_20091 |   -9.395186    -8.941228       -.4539579               .
     d_20092 |   -9.867174    -9.521504       -.3456704               .
     d_20101 |   -7.723994    -7.014815       -.7091793               .
     d_20102 |    -7.80975    -7.114289       -.6954612               .
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                 chi2(22) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =      141.47
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

Source: Author's computations in STATA

Table AP26: Inflation Rate, Robust FE Model

```
xtreg act_infl fc_infl d_20002-d_20102, robust fe

Fixed-effects (within) regression               Number of obs      =       660
Group variable: country                         Number of groups   =        30

R-sq:  within  = 0.5047                         Obs per group: min =        22
       between = 0.9669                                        avg =      22.0
       overall = 0.6178                                        max =        22

                                                F(22,29)           =  14188.24
corr(u_i, Xb)  = 0.4582                         Prob > F           =    0.0000

                              (Std. Err. adjusted for 30 clusters in country)
------------------------------------------------------------------------------
             |               Robust
    act_infl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     fc_infl |   .5819715   .0286782    20.29   0.000     .5233181    .6406249
     d_20002 |  -3.713754   4.245819    -0.87   0.389    -12.39743     4.96992
     d_20011 |  -6.119541   6.143192    -1.00   0.327    -18.68378    6.444697
     d_20012 |   -5.11347    4.97536    -1.03   0.313    -15.28922    5.062283
     d_20021 |  -6.472516   4.483587    -1.44   0.160    -15.64248     2.69745
     d_20022 |  -6.892614   4.472759    -1.54   0.134    -16.04043    2.255205
     d_20031 |  -7.716271   4.801816    -1.61   0.119    -17.53709    2.104545
     d_20032 |  -7.836545   4.806648    -1.63   0.114    -17.66724    1.994155
     d_20041 |  -7.559026   5.096388    -1.48   0.149    -17.98231    2.864258
     d_20042 |  -7.680147   5.185109    -1.48   0.149    -18.28489    2.924591
     d_20051 |  -7.588641   5.253752    -1.44   0.159    -18.33377    3.156489
     d_20052 |  -7.763779   5.316896    -1.46   0.155    -18.63805    3.110495
     d_20061 |  -7.780882   5.331282    -1.46   0.155    -18.68458    3.122814
     d_20062 |  -7.946594   5.371741    -1.48   0.150    -18.93304    3.039851
     d_20071 |  -7.331561   5.363353    -1.37   0.182    -18.30085    3.637727
     d_20072 |  -7.522412   5.271986    -1.43   0.164    -18.30483    3.260011
     d_20081 |  -4.849074   5.236435    -0.93   0.362    -15.55879    5.860639
     d_20082 |  -5.136179   5.122043    -1.00   0.324    -15.61193    5.339574
     d_20091 |  -9.395186   5.063623    -1.86   0.074    -19.75146    .9610865
     d_20092 |  -9.867174   5.060568    -1.95   0.061     -20.2172    .4828492
     d_20101 |  -7.723994   5.269476    -1.47   0.153    -18.50128    3.053294
     d_20102 |   -7.80975   5.324718    -1.47   0.153    -18.70002     3.08052
       _cons |   9.854828   4.965399     1.98   0.057    -.3005528    20.01021
-------------+----------------------------------------------------------------
     sigma_u |  3.4949115
     sigma_e |  7.0878408
         rho |  .19558105   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Source: Author's computation in STATA

Table AP27: Inflation Rate, LSDV Model: Test for Efficiency

```
Restriction set
 1: b[const] = 0
 2: b[Fc_Infl] = 1

Test statistic: F(2, 608) = 510.285, with p-value = 8.26989e-131

Restricted estimates:

                coefficient   std. error   t-ratio    p-value
  ------------------------------------------------------------
  const           0.000000     0.000000    NA         NA
  Fc_Infl         1.00000      0.000000    NA         NA
  d_2000_2       -4.03390      1.93536     -2.084      0.0375   **
  d_2001_1       -4.53556      1.93536     -2.344      0.0194   **
  d_2001_2       -2.80923      1.93536     -1.452      0.1471
  d_2002_1       -3.25056      1.93536     -1.680      0.0936   *
  d_2002_2       -3.93890      1.93536     -2.035      0.0423   **
  d_2003_1       -4.32223      1.93536     -2.233      0.0259   **
  d_2003_2       -4.52890      1.93536     -2.340      0.0196   **
  d_2004_1       -3.74556      1.93536     -1.935      0.0534   *
  d_2004_2       -3.94890      1.93536     -2.040      0.0417   **
  d_2005_1       -3.55223      1.93536     -1.835      0.0669   *
  d_2005_2       -3.85556      1.93536     -1.992      0.0468   **
  d_2006_1       -3.73890      1.93536     -1.932      0.0538   *
  d_2006_2       -4.11223      1.93536     -2.125      0.0340   **
  d_2007_1       -3.39826      1.93536     -1.756      0.0796   *
  d_2007_2       -3.72010      1.93536     -1.922      0.0550   *
  d_2008_1       -0.925531     1.93536     -0.4782     0.6327
  d_2008_2       -1.41886      1.93536     -0.7331     0.4638
  d_2009_1       -5.66303      1.93536     -2.926      0.0036   ***
  d_2009_2       -6.46533      1.93536     -3.341      0.0009   ***
  d_2010_1       -3.21333      1.93536     -1.660      0.0974   *
  d_2010_2       -3.34093      1.93536     -1.726      0.0848   *
  d_country2      3.61496      2.14403      1.686      0.0923   *
  d_country3      3.86764      2.14403      1.804      0.0717   *
  d_country4      2.73591      2.14403      1.276      0.2024
  d_country5      4.14387      2.14403      1.933      0.0537   *
  d_country6      5.83714      2.14403      2.723      0.0067   ***
  d_country7      3.69487      2.14403      1.723      0.0853   *
  d_country8      4.67241      2.14403      2.179      0.0297   **
  d_country9      3.63455      2.14403      1.695      0.0905   *
  d_country10     3.92446      2.14403      1.830      0.0677   *
  d_country11     4.36914      2.14403      2.038      0.0420   **
  d_country12     4.03005      2.14403      1.880      0.0606   *
  d_country13     4.76841      2.14403      2.224      0.0265   **
  d_country14     4.15641      2.14403      1.939      0.0530   *
  d_country15     4.96646      2.14403      2.316      0.0209   **
  d_country16     3.62064      2.14403      1.689      0.0918   *
  d_country17     4.13073      2.14403      1.927      0.0545   *
  d_country18     7.18614      2.14403      3.352      0.0009   ***
  d_country19     3.91605      2.14403      1.826      0.0683   *
  d_country20     3.45005      2.14403      1.609      0.1081
  d_country21     3.34023      2.14403      1.558      0.1198
  d_country22     3.96409      2.14403      1.849      0.0650   *
  d_country23     7.97173      2.14403      3.718      0.0002   ***
  d_country24     5.24532      2.14403      2.446      0.0147   **
  d_country25     4.02264      2.14403      1.876      0.0611   *
  d_country26     3.55246      2.14403      1.657      0.0981   *
  d_country27     3.50818      2.14403      1.636      0.1023
  d_country28     8.65773      2.14403      4.038      6.08e-05 ***
  d_country29     5.69968      2.14403      2.658      0.0081   ***
  d_country30     3.68500      2.14403      1.719      0.0862   *

  Standard error of the regression = 8.46373
```

Source: Author's computations in GRETL

Table AP28: Inflation Rate, FE Model: Test for Efficiency

```
Restriction set
 1: b[const] = 0
 2: b[Fc_Infl] = 1

Test statistic: F(2, 608) = 493.071, with p-value = 5.47572e-128
```

Source: Author's computations in GRETL

Table AP29: Inflation Rate, Forecast Errors

Country	Average Error	Sum of Errors	Maximum Error	Minimum Error
	$\frac{\sum_{t=1}^{22} e_t}{22}$	$\sum_{t=1}^{22} e_t$	$max\ (e_t)$	$min\ (e_t)$
Albania	-0.3680	-8.0950	2.4000	-6.0000
Armenia	0.0460	1.0110	5.2000	-8.7000
Austria	0.2986	6.5700	1.5230	-1.8540
Belarus	-0.8331	-18.3280	139.000	-86.740
Belgium	0.5749	12.6470	2.6930	-2.8420
Bulgaria	2.2681	49.8990	8.3500	-4.5470
Denmark	0.1259	2.7690	2.3280	-1.4810
Estonia	1.1034	24.2750	5.0660	-5.1420
Finland	0.0655	1.4420	2.3000	-1.6000
France	0.3555	7.8200	1.3590	-1.5640
Georgia	0.8001	17.6030	8.4070	-5.8730
Germany	0.4610	10.1430	2.7000	-1.5160
Hungary	1.1994	26.3870	5.2350	-1.6000
Italy	0.5874	12.9230	4.7000	-3.0000
Latvia	1.3975	30.7440	12.7520	-7.3770
Lithuania	0.0516	1.1360	7.7380	-4.2000
Luxembourg	0.5617	12.3580	1.8000	-1.4660
Moldova	3.6171	79.5770	28.4900	-9.6600
Netherlands	0.3470	7.6350	4.3000	-1.6160
Norway	-0.1190	-2.6170	1.5660	-2.1000
Poland	-0.2288	-5.0330	4.6000	-3.8000
Portugal	0.3951	8.6920	2.5000	-2.9440
Romania	4.4027	96.8600	28.9000	-3.8000
Russia	1.6763	36.8790	6.8800	-3.0500
Spain	0.4536	9.9800	1.4300	-3.2910
Sweden	-0.0165	-0.3640	1.9080	-1.3000
Switzerland	-0.0608	-1.3380	1.4300	-1.9830
Turkey	5.0887	111.9520	37.4300	-18.7000
UK	0.1160	2.5520	2.5630	-1.4000
Ukraine	2.1307	46.8750	18.7700	-11.5000
TOTAL	0.8833	582.9540	139.0000	-86.7400

Source: Author's computations in Excel

Table AP30: Inflation Rate, LSDV Model: Test for Unbiasedness

```
Pooled OLS, using 660 observations
Included 30 cross-sectional units
Time-series length = 22
Dependent variable: Fc_Error_Infl

                  coefficient   std. error   t-ratio    p-value
  ------------------------------------------------------------------
  const             0.883264     0.191305      4.617    4.68e-06  ***
  LSDV_infla_rsd    1.00000      0.0281211    35.56     2.42e-155 ***

Mean dependent var   0.883264   S.D. dependent var   8.394486
Sum squared resid    15893.62   S.E. of regression   4.914717
R-squared            0.657745   Adjusted R-squared   0.657225
F(1, 658)            1264.545   P-value(F)           2.4e-155
Log-likelihood      -1986.372   Akaike criterion     3976.745
Schwarz criterion    3985.729   Hannan-Quinn         3980.227
rho                  0.500880   Durbin-Watson        0.908610
  ------------------------------------------------------------------

Restriction:
 b[const] = 0

Test statistic: F(1, 658) = 21.3171, with p-value = 4.682e-006

Restricted estimates:

                  coefficient   std. error   t-ratio    p-value
  ------------------------------------------------------------------
  const             0.000000     0.000000      NA       NA
  LSDV_infla_rsd    1.00000      0.0285513     35.02     1.37e-152 ***

  Standard error of the regression = 4.9899
```

Source: Author's computations in GRETL

Table AP31: Inflation Rate, FE Model: Test for Unbiasedness

```
Pooled OLS, using 660 observations
Included 30 cross-sectional units
Time-series length = 22
Dependent variable: Fc_Error_Infl

                  coefficient   std. error   t-ratio    p-value
  ------------------------------------------------------------
  const            0.883264     0.191305      4.617    4.68e-06  ***
  FE_infl_resid    1.00000      0.0281211    35.56     2.42e-155 ***

Mean dependent var   0.883264   S.D. dependent var   8.394486
Sum squared resid    15893.62   S.E. of regression   4.914717
R-squared            0.657745   Adjusted R-squared   0.657225
F(1, 658)            1264.545   P-value(F)           2.4e-155
Log-likelihood      -1986.372   Akaike criterion     3976.745
Schwarz criterion    3985.729   Hannan-Quinn         3980.227
rho                  0.500880   Durbin-Watson        0.908610

  ------------------------------------------------------------

Restriction:
 b[const] = 0

Test statistic: F(1, 658) = 21.3171, with p-value = 4.682e-006

Restricted estimates:

                  coefficient   std. error   t-ratio    p-value
  ------------------------------------------------------------
  const            0.000000     0.000000      NA       NA
  FE_infl_resid    1.00000      0.0285513     35.02     1.37e-152 ***

  Standard error of the regression = 4.9899
```

Source: Author's computations in GRETL